630.14
C16
no. S1 Ed2

LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

DOMINION OF CANADA DEPARTMENT OF AGRICULTURE

SEED BRANCH

GEO. H. CLARK, SEED COMMISSIONER AND OFFICIAL SEED ANALYST

THE SEED CONTROL ACT

REPRINTED FROM

THE REVISED STATUTES OF CANADA, 1906, VOL. III., CHAP. 128

WITH

GENERAL EXPLANATIONS

AND

RULES FOR TAKING SAMPLES AND METHODS OF SEED TESTING

Bulletin No. S. 1, Revised Edition

Published by the direction of the HON. SYDNEY A. FISHER, *Minister of Agriculture, Ottawa, Canada.*

July, 1907
4457—1

630.14
C16
no S-1 Ed 2

THE SEED CONTROL ACT

CHAPTER 128.

An Act respecting the Inspection and Sale of Seeds.

SHORT TITLE.

1. This Act may be cited as the Seed Control Act. 4-5 E. VII., c. 41, s. 1. Short title.

REGULATIONS.

Regulations by Governor in Council.

2. The Governor in Council may make,—

(*a*) regulations determining the maximum proportion of seeds of the weeds named in this Act that may be tolerated in any other seeds without affecting their character as being free from the seeds of the said weeds within the meaning of this Act; and,

(*b*) such regulations as he considers necessary in order to secure the efficient enforcement and operation of this Act.

Penalties.

2. The Governor in Council may, by such regulations, impose penalties not exceeding fifty dollars on any person offending against them, to be recoverable on summary conviction.

Publication.

3. The regulations so made shall be in force from the date of their publication in the *Canada Gazette*, or from such other date as is specified in the proclamation in that behalf. 4-5 E. VII., c. 41, ss. 5 and 17.

EXAMINATION.

Examination of seeds.

3. Any person charged with the enforcement of this Act may enter upon any premises to make any examination of any seeds, receptacles, packages, sacks or bags of seeds, with respect to which he has reason to suspect or believe that any provision of this Act is being violated, whether such seeds, receptacles, packages, sacks or bags of seeds are on the premises of the owner, or on other premises, or in the possession of a railway or steamship company, and may take any samples of the said seeds from any receptacle, package, sack or bag, for which samples the owner of the seed shall be paid in accordance with the amount of seed thus taken and its current value. 4-5 E. VII., c. 41, s. 10.

LIMITATION.

Exceptions from Act.

4. The provisions contained in this Act shall not apply to,—

(*a*) any person growing or selling seeds for the purpose of food in respect of seed sold, or exposed or had in possession for sale, for such purposes;

(*b*) any person selling seeds direct to merchants to be cleaned or graded before being offered for sale for the purpose of seeding in respect of seeds sold, or exposed or had in possession for sale, for such purpose;

(*c*) seed that is held in storage for the purpose of being recleaned, and which has not been offered, exposed or held in possession for sale for the purpose of seeding;

(*d*) seed marked 'not absolutely clean' and held or sold for export only. 4-5 E. VII., c. 41, s. 7.

p27462

Further exception.

5. The provisions contained in the next following section shall not apply to the sale of seed that is grown, sold and delivered by any farmer on his own premises, for seeding by the purchaser himself, unless the purchaser of the said seed obtains from the seller at the time of the sale thereof a certificate that the said seed is supplied to him subject to the provisions of this Act. 4-5 E. VII., c. 41, s. 3.

PROHIBITORY CLAUSES.

Seeds to be free from seeds of certain weeds.

6. No person shall sell, or offer, expose or have in his possession for sale, for the purpose of seeding, any seeds of cereals, grasses, clovers or forage plants, unless they are free from any seeds of the following weeds:—Wild Mustard or Charlock (*Brassica Sinapistrum*, Boiss.); Tumbling Mustard (*Sisymbrium Sinapistrum*, Crantz.); Hare's Ear Mustard [*Coringia orientalis*, (L.) Dumort]; Ball Mustard (*Neslia paniculata*, Desv.); Field Pennycress or Stinkweed (*Thlaspi arvense*, L.); Wild Oats (*Avena fatua*, L. and *Avena strigosa*, Schreb.); Bindweed (*Convolvulus arvensis*, L.); Perennial Sow-Thistle (*Sonchus arvensis*, L.); Ragweed (*Ambrosia artemisiaefolia*, L.); Great Ragweed (*Ambrosia trifida*, L.); Purple Cockle (*Lychnis Githago*, Lam.); Cow Cockle [*Vaccaria* Vaccaria (L.) Britton]; Orange Hawkweed or Paint Brush (*Hieracium aurantiacum*, L. and *Hieracium praealtum*, Vill.); and from the Sclerotia known as Ergot of Rye (*Claviceps purpurea*, Tul.); unless each and every receptacle, package, sack or bag containing such seeds, or a label securely attached thereto, is marked in a plain and indelible manner,—

(*a*) with the full name and address of the seller;
(*b*) with the name of the kind or kinds of seed;
(*c*) with the common name or names of the weeds hereinbefore named, the seeds of which are present in the seed sold or offered, exposed or had in possession for sale. 4-5 E. VII., c. 41, s. 3.

Grades.

7. No person shall sell, or offer, expose or have in his possession for sale, any seeds of timothy, red clover, alsike, or any mixture containing the said seeds, in or from any receptacle, package, sack or bag upon which is marked 'No. 1' or any other designation which represents such seeds as of first quality, unless they are free from the seeds of weeds named in the last preceding section, and are also free from the seeds of White Cockle (*Lychnis vespertina*, Sibth.); Night-Flowering Catchfly (*Silene noctiflora*, L.); False Flax (*Camelina sativa*, Crantz.); Canada Thistle (*Cnicus arvensis*, Hoffm.); Ox-eye Daisy (*Chrysanthemum Leucanthemum*, L.); Curled Dock (*Rumex crispus*, L.); Blue Weed (*Echium vulgare*, L.); Ribgrass (*Plantago lanceolata*, L.); Chicory (*Cichorium Intybus*, L.), and contain out of every one hundred seeds not less than ninety-nine seeds of the kind or kinds represented, or seeds of other useful and harmless grasses and clovers, of which ninety-nine seeds, ninety seeds must be germinable. 4-5 E. VII., c. 41, s. 4.

Proportion of prohibited seeds allowed.

8. No person shall sell, or offer, expose or have in his possession for sale, for the purpose of seeding in Canada, any seeds of timothy, alsike or red clover, or any mixture containing the said seeds, if the seeds of the weeds named in this Act are present in a greater proportion than five to one thousand of the seed sold, or offered, exposed or held in possession for sale. 4-5 E. VII., c. 41, s. 6.

OFFENCES AND PENALTIES.

Penalty for selling seeds containing

9. Except as in this section otherwise provided, every person who, by himself or through the agency of another person sells, offers, exposes or has in possession for sale, seeds, in violation of any of the provisions of this Act shall be guilty of an offence and upon summary conviction therefor, be liable for a first offence to a fine not exceeding one dollar, and for each subsequent offence to a fine not exceeding five dollars, for each receptacle, package, sack or bag in or from which seeds are sold, offered, exposed or had in possession for sale contrary to such provision together with the costs of prosecution, and, in default of immediate payment of such fine and costs, shall be liable to imprisonment, for a term not exceeding one month, unless such fine and costs of enforcing the same are sooner paid: Provided that the total amount of the fine shall not exceed, in the case of a first offence, five dollars, and in the case of a subsequent offence, twenty-five dollars. seeds of weeds. Proviso.

2. If the accused proves to the magistrate before whom he is tried that the package, sack, bag or receptacle containing the seed respecting which the complaint or information is laid, was purchased by him directly from a seed merchant domiciled in Canada, and was not opened, or the state of the seed was not altered, while it was in his possession, and he had no reason to believe that the seed did not comply with the provisions of this Act, he shall, upon disclosing the name of the person from whom he purchased the seed, and the place and date of the sale thereof to him, not be liable beyond the costs of prosecution. Liability of purchaser in good faith.

3. Every magistrate who has disposed of any case under the foregoing subsection shall, within one month from the date of his judgment therein, send to the Minister of Agriculture a report of the case, giving the name of the accused, the name of the person who sold the seed to him, and the date and place of such sale. Report of magistrate.

4. Any prosecution against any person, pursuant to a report made to the Minister of Agriculture respecting that person, under the last foregoing subsection may be commenced within twelve months from the time when the matter of complaint or information arose, and not later. 4-5 E. VII., c. 41, ss. 8 and 18. Time for prosecution limited.

10. Every person who obstructs any person charged with the enforcement of this Act in entering any premises to make examination of seeds, receptacles, packages, sacks or bags of seeds, as provided by this Act, or who refuses to permit the making of any such examination, or the taking of samples of seeds as provided by this Act, shall, upon summary conviction, be liable to a penalty not exceeding five hundred dollars and not less than twenty-five dollars, together with the costs of prosecution; and in default of payment of the said penalty and costs, shall be liable to imprisonment for a term not exceeding six months, unless the said penalty and costs and the costs of enforcing the same are sooner paid. 4-5 E. VII., c. 41, s. 10. Preventing the examination of seeds. Or the taking of samples. Penalty.

11. The person on whose behalf any seed is sold, offered, exposed, or had in possession for sale, contrary to the provisions of this Act, shall be *prima facie* liable for the violation of this Act. 4-5 E. VII., c. 41, s. 9. Who shall be *prima facie* liable.

ANALYSIS.

12. Any purchaser of seeds, with respect to which he has reason to suspect or believe that any provision of this Act has been violated, or any person charged with the enforcement of this Act, at his request, may take a sample from the said seeds and forward it to such person as the Governor in Council appoints as an official seed analyst to examine and report upon any seed submitted for analysis under the provisions of this Act. 4-5 E. VII., c. 41, s. 11. Samples to be sent to official analyst.

To be taken in presence of seller and two witnesses.

Certificate to accompany samples.

13. Any sample of seed taken for official analysis under the provisions of this Act shall be taken in the presence of,—

(*a*) the person who sold or offered, exposed or had in his possession for sale the said seeds; or,

(*b*) two impartial or non-interested witnesses; and,

in accordance with the rules for seed testing prescribed by the Minister of Agriculture, and shall be inclosed in a sealed package, together with a certified statement of the person taking the sample, which statement shall include the name and address of the person who sold, or offered, exposed or had in his possession for sale, the seeds from which the said sample was taken, the manner in which the receptacle, package, sack or bag was marked, and the section or sections of this Act in violation of which the said seeds were found or suspected to be sold or offered, exposed or had in possession for sale. 4-5 E. VII, c. 41, s. 12.

Samples to be sent within seven days.

14. Any sample of seeds taken from any seed which are found or suspected to be sold in violation of the provisions of this Act shall be taken and forwarded to an official seed analyst,—

(*a*) from seeds that are sold in sealed packages, sacks, bags or receptacles, at the time of the breaking of the seal thereon; and,

(*b*) from seeds that are not sold in sealed packages, sacks, bags or receptacles, within seven days from the date on which the seeds entered into the personal possession and became the property of the purchaser. 4-5 E. VII., c. 41, s. 13.

Analysis and certificate.

15. It shall be the duty of any official seed analyst to examine any seeds sent to him in accordance with the provisions of this Act, by following the methods for testing seeds prescribed by the Minister of Agriculture, and to send one certificate of analysis of the said seeds to the inspector, informant or complainant from whom they were received, and one certificate to the seller of the said seeds, and to place one certificate on file in the Department of Agriculture. 4-5 E. VII., c. 41, s. 14.

EVIDENCE AND PROCEDURE.

Certificate as evidence.

16. The certificate of analysis of any official seed analyst on any sample of seeds forwarded to him under this Act shall be accepted as evidence in any prosecution of any person charged with having sold or offered, exposed or had in his possession for sale, in violation of the provisions of this Act, seeds from which the sample purports to have been taken, or of any person from whom such person purchased the seeds. 4-5 E. VII., c. 41, s. 15.

Place of offence.

17. In any complaint, information or conviction under this Act, the matter complained of may be declared, and shall be held to have arisen, within the meaning of Part XV. of the Criminal Code, at the place where the seed was sold or offered, exposed or had in possession for sale. 4-5 E. VII., c. 41, s. 16.

GENERAL COMMENTS.

It is not the object of this Act to require farmers to purchase for their own use any seeds of a better quality than they desire, except (section 8) in so far as noxious weeds are held to be a public nuisance. The Act is intended to provide the means by which the users of seed may protect themselves against the introduction of noxious weeds on their lands; and to fix a minimum standard in respect to purity and vitality for timothy, alsike and red clover seeds that may be represented to be of first quality, and thus provide the means by which careful seedsmen may protect themselves against the designs or carelessness of unscrupulous seed vendors.

To assist seed merchants in the conduct of their business under the Act, the Seed Branch of the Department of Agriculture at Ottawa, has prepared for distribution, at a nominal cost of $2, to seed merchants and agricultural institutions such as agricultural schools, farmers' institutes and agricultural societies, collections of authentic specimens of seeds of 100 species of weeds, and other economic plants—including all of those mentioned in the Act. With one of these collections of seeds in his possession, any person of ordinary intelligence would have the means of testing seeds in respect to the provisions of the Act.

The term "Government Standard" applied to Timothy, Alsike or Red Clover seeds, does not mean that the seed is of "No. 1" quality, as provided under Section 7 of the Seed Control Act, which fixes the standard for seeds which may be marked "No. 1" or otherwise represeted to be of first quality. The term "Government Standard" has been largely used with seeds which were sufficiently clean to meet the provisions of the minimum standard fixed in Section 8 of the Seed Control Act, which allows 92 seeds of the weeds named in the Act per one ounce of Red Clover; 212 per ounce of Alsike, and 410 per ounce of Timothy seed.

The following quotation is taken from a circular, issued by an Ontario retail seed merchant, which is exceedingly misleading. "We have decided to sell only *standard seed*, every bag under *Government seal*, thus insuring you clean seed."

There is no Government in Canada which assumes to inspect any seeds before they are offered for sale for seeding. Some reliable seed houses sell grass and clover seeds in bags sealed by them with a lead seal. No Government seal is used on any seeds offered for sale in the trade. Seed purchasers who desire Timothy, Alsike or Red Clover seeds of first quality should see to it that the goods they purchase are marked "No. 1" or otherwise clearly represented to be of first quality.

Under the Seed Control Act (section 14), wholesale seed merchants have the privilege of selling seeds in sealed packages or bags sealed by them, thus relieving retail merchants of any responsibility connected therewith, so long as the seal thereon remains intact.

DUTIES OF SEED INSPECTORS.

Seed inspectors are instructed to visit seed houses and retail stores, in all parts of the districts assigned to them, for the purpose of making examination of any seeds that may be offered for sale for seeding and to take samples for official test from any seeds that are suspected by them to be offered for sale for seeding contrary to the provisions of the Seed Control Act. Seed inspectors are not permitted, at any time, to inspect seeds for seed merchants, for the purpose of passing upon their grading, prior to such seeds being offered for sale, either in sealed packages or in bulk. Seed inspectors will receive instructions, whenever possible, to examine into any complaints regarding seeds that may be suspected to be sold or offered for sale in violation to the Seed Control Act, on receipt of such complaint at the office of the Department of Agriculture. It is nevertheless the privilege of any citizen to put the Act into operation and enter prosecutions against any person who may be found to have violated the provisions of the Act.

Section 14, clause (*b*) "within seven days from the date when the seeds entered into his personal possession." It is the purpose of this clause to allow any purchaser of seeds whether he be a seed merchant or farmer, a period of seven days from the time when the seeds entered into his possession, during which time he may make complaint and take sample of the seeds for test as prescribed in section 13. Should no complaint be made and sample taken within seven days the purchaser must alone assume the responsibility.

APPENDIX.

RULES FOR SEED TESTING UNDER THE SEED CONTROL ACT.

HOW SAMPLES ARE TO BE TAKEN.

Sampling Seeds.—Samples for analysis must be drawn in the presence of,—

(*a*) the person who sold or offered, exposed or held in possession for sale the seeds, or

(*b*) two impartial and non-interested witnesses.

In order to insure that the samples sent to the Official Seed Analyst represent the bulk of the goods, the contents of packages, sacks or bags, should be emptied out, mixed thoroughly and *small quantities* taken from different parts to make the sample sent to the official seed analyst for analysis. If the seeds be taken from sealed sacks or bags containing more than one bushel of seed, or if it be impracticable thus to mix the goods, small quantities should be drawn *to make the sample;* from the top, middle and bottom of each sack or bag, when there are not more than six sacks or bags; from the top, middle and bottom of every second sack or bag when there are from seven to twelve sacks or bags; and from the top, middle and bottom of every fourth sack or bag, when there are more than twelve sacks or bags. "Seed tryers" and grain tryers may be used for this purpose. The sample thus obtained must be inclosed in a suitable package, sealed and forwarded to an official seed analyst.

Samples of seed must be accompanied by a certified statement of the inspector, informant or complainant, which shall include the name and address of the person who sold or offered, exposed or had in his possession for sale, the seeds from which the said sample was taken; the manner in which the receptacle, package, sack or bag was marked; and the section or sections of this Act in violation of which the said seeds were found or suspected to be sold or offered, exposed or had in possession for sale.

The minimum of weight of seeds to be forwarded for official test to any official seed analyst shall be—

2 ounces of grass seeds of all kinds, white and alsike clovers.

4 ounces, red clover, alfalfa, millet, and seeds of like size.

1 pound of cereals, and seeds of like size.

METHODS FOR TESTING SEEDS.

How Purity Tests Shall be conducted.

The Average Sample.—The sample that is examined in the laboratory to determine the amount of impurities shall be carefully drawn from the larger amount forwarded for analysis, and shall consist of not less than—

2 grams of agrostis, the poas or yellow oat grass.

5 grams of alsike and white clover and all grasses except agrostis, the poas and yellow oat grass.

10 grams melilotus, medicago, millet, and all species of clover seed, except alsike and white.

50 grams of cereals, peas, beans and other large seeds.

Whsn the amount of impurities is unusually large, two average samples shall be drawn and exaemined.

The report of purity tests shall state:—

(*a*) the name of the kind or kinds and the number of the seeds of weeds named in section 6 of the Seed Control Act, which are found in the weighed sample.

(b) for timothy, alsike or red clover, the names of the kind or kinds and the number of the seeds of weeds named in sections 6 and 7 of the Seed Control Act which are found in the weighed sample;

(2) the total number of seeds of weeds named in sections 6 and 7 of the Seed Control Act per 1,000 of the kind or kinds of seed examined; and

(3) for timothy, alsike and red clover that are marked "No. 1" or otherwise represented to be of first quality, the common and botanical names and the total number of the useless and harmful seeds of weeds not named in the Act, that were found in the sample per 100 of the seeds examined.

How Germination Tests of Timothy, Alsike and Red Clover Seeds shall be Conducted.

1. All germination tests shall be conducted in the Standard Seed Germinator.

2. The seed for germination tests shall be drawn from pure seed that has been thoroughly mixed for the purpose.

3. Two hundred seeds shall be accurately counted for each single test.

4. The seed to be tested for germination shall be placed between folds of heavy sterilized blotting paper, which shall be kept moistened until the test is completed.

5. In the case of all germination tests of timothy, alsike and red clover seed, the seeds shall be examined each day while the test is in progress. Those which have germinated shall be counted and removed from the germination bed and the number of such seeds recorded.

6. The duration of all tests of timothy seed shall be fourteen days, at the end of which time only those seeds which have germinated shall be considered as capable of germination. The number of such seed shall be stated in the report.

7. The duration of all tests of alsike and red clover shall be ten days, at the end of which time all seeds which have germinated shall be recorded. In addition one-third of the number of seeds which have remained hard and sound shall be counted as capable of germinating, and included with those which have germinated, in making out the report.

8. Each germination test shall be conducted in duplicate, simultaneously and under identical conditions. When the duplicate tests vary more than five per cent, they shall be discarded and other tests made. The average result of the duplicate tests shall be stated in the report, but seeds marked No. 1 shall not be held to be falsely marked in respect to their vitality unless the per cent of germinable seeds, as shown by the said report, be more than five per cent below the minimum number required for seeds marked No. 1, as provided in clause 7 of the Act.

9. The temperature of the germinating chamber during germination tests of timothy shall be kept, as nearly as practicable, at 20° C., for eighteen hours per day, and raised to 30° C., during six hours per day, each day until the test is completed.

10. The temperature of the germinating chamber during germination tests of alsike and red clover seeds shall be kept, as nearly as practicable, at 20° C., during eighteen hours per day, and lowered to 18° C., during six hours per day until the test is completed.

11. In no case shall the temperature be higher than 32° C., or lower than 15° C., during these germination tests.

PRESERVING SAMPLES.

A sufficient amount of seed for a complete test for both purity and germination of each sample shall be kept in the seed laboratory for one year, in a dark, dry and cool place.

RECORD.

Records shall be kept of all samples received, together with all information regarding their origin, time received, dates on which tests are made, and a complete report of the results of their analysis.

STANDARDS OF QUALITY FOR TIMOTHY, ALSIKE AND RED CLOVER SEEDS.

(Sections 6 and 7 which are modified by section 2*a*; and also section 8.)

The following table gives the maximum number of weed seeds that may be permitted in Timothy, Alsike or Red Clover seeds that are offered for sale for seeding in Canada. (Computed from seeds that are average in size as shown by the above table.)

Kind of Seed.	No 1 quality, Section 7.		Section 8.
	*a Weed seeds tolerated (Section 2, a. 1–1500).	*b Other weed seeds allowed. (1–100).	(5 weed seeds per 1,000 of the good seeds).
	Maximum number per ounce.	*Maximum number per ounce.*	*Maximum number per ounce.*
Timothy	55	822	410
Alsike	28	425	212
Red Clover	12	184	92

One ounce = 28⅓ grams.

*a. The regulation made by the Governor in Council under Section 2 of the Act is subject to change. One seed of the weeds named in the Act per 1,500 of the good seed for grass and clover seeds and seeds of like size, and one seed of weeds named in Section 6 per one pound of seed of cereal grains has been allowed as a margin of tolerance since the Act has been in force.

*b. Timothy, Alsike or Red Clover seeds marked No. 1 or otherwise represented to be of first quality must not contain more than one seed of other weeds such as Foxtail, Black Medick, &c., per 100 of the good seeds and must germinate 90 per cent or more.

GENERAL EXPLANATIONS AND INSTRUCTIONS.

Section 6.—When the seeds of weeds named in section 6 are present in seed of cereals, grasses, clovers or forage plants that are sold or offered for sale, for the purpose of seeding, by any seed merchant, information required by the said section, showing that such weed seeds are present, may be given after the plan of the following form:—

(Name of Seed Merchant)...
(P. O. Address)...
Containing seed of........................(Name or names of weeds)...............

Any seed merchant may, at his own discretion, state the proportion in which such weed seeds are present as impurities.

Section 5.—Any farmer may, at his own discretion, supply purchasers of seeds with a certificate which may contain information as outlined in the following form:—

This is to certify that the..........bushels of seed of..........................
which I have this day sold to..............................of....................
is sold by me subject to the provisions of the Seed Control Act.

Dated at........................
this......day of......., 190 .

(Signed)

....

Without such certificate, no person who purchases seed for his own use and accepts the same from any farmer who is on his own premises and on which the seed was grown by him, may hold the said farmer subject to the provisions of section 6 of this Act in respect to the seed so purchased. In all other sections of the Act farmers may be held to be liable.

Section 7.—'No. 1,' 'Finest,' 'Best,' 'Choice,' 'XXX,' 'Fancy,' 'Selected' and 'Prime,' are some of the terms that are generally held to indicate first or superior quality in articles of commerce.

The following table gives the maximum, minimum and average number of grains of seeds per ounce as determined in the seed laboratory by counting the seeds in one gram taken from each of 17 samples of each of timothy, alsike and red clover seeds. To obtain the maximum number of seeds per ounce, one sample of pure seed of the smallest obtainable seeds of each kind was used. For the minimum number of seeds per ounce one sample of pure seed of the largest obtainable seeds of each kind was used. The average number of seeds per ounce was determined from 15 samples of pure seed of each kind that had been received direct from farms in various parts of the Provinces of Ontario and Quebec.

—	NUMBER OF SEEDS.		
	Maximum. (Small seed)	Minimum. (Large seed)	Average.
Timothy, 1 ounce	130,410	56,700	82,215
Alsike, 1 ounce	70,875	39,690	42,525
Red Clover, 1 ounce	36,855	12,757	18,427

630.14
C16
no.S2

DOMINION DEPARTMENT OF AGRICULTURE
BRANCH OF THE SEED COMMISSIONER
OTTAWA, CANADA

THE PRODUCTION AND USE OF SEED GRAIN

BULLETIN No. S. 2.

Published by direction of the Hon. SYDNEY A. FISHER, Minister of Agriculture, Ottawa, Ont.

NOVEMBER, 1905

THE PRODUCTION AND USE OF SEED GRAIN

BY

JAMES MURRAY, B.S.A.

District Representative for the Provinces of Manitoba and Saskatchewan

SUMMARY OF CONTENTS

The seed: What it is; its functions—Why good seed is required—Varieties—Mixed varieties—Weeds—Seed of wild and cultivated oats (illustrated)—Size of seed—Ripe and immature seed—Frozen grain for seed—Seed from a rusted crop—The growing of seed—Seed and soil—The amount of seed per acre—Stacking *versus* stook threshing—Cleaning—Changing seed—Hand selection of seed—Treating for smut—Testing Seeds—Summary.

Office of the Seed Commissioner,
Ottawa, November 15, 1905.

The Honourable,
The Minister of Agriculture.

Sir,—I beg to transmit herewith a bulletin on the production and use of seed grain. The matter contained therein has been prepared by James Murray, B.S.A., who has been in the employ of this Branch since June, 1902. During the last two years Mr. Murray has given his whole attention to encouraging the production and use of high class seeds in the western provinces and has had a good opportunity to study the conditions and needs of farmers throughout the grain growing districts. I recommend that the bulletin be printed for general distribution throughout the provinces of Manitoba, Saskatchewan and Alberta.

I have the honour to be, sir,
Your obedient servant,

GEORGE H. CLARK,
Seed Commissioner.

THE PRODUCTION AND USE OF SEED GRAIN

The object of this bulletin is to present to those interested and engaged in grain growing in Western Canada, some facts regarding the growing and use of cereal seeds, in the hope that they may be found useful in promoting increased yield and improved quality in grain crops. No effort is made to cover all the various points to be observed in the production of grain in Manitoba, Saskatchewan, and Alberta. This would demand a volume. Of the information which this bulletin contains, much has already been given publicity in text books, and to a certain extent in bulletins. As thus presented, with no effort made to give those parts relating to seed any special prominence, they often appear fragmentary and disconnected. Unless brought together in some other form, various important facts regarding the value of seed, its production and handling, are never seen, or are quickly lost to view, by those to whom they would be most useful. While, therefore, the bulletin contains little that is new, it is hoped that the form of presentation may commend itself to those whom it reaches, and that useful service may thus be rendered in forwarding the greatest industry of the prairie provinces.

THE SEED—WHAT IT IS; ITS FUNCTION.

In grain, that which is called *seed*, is the ripened product of the plant, that which the plant lives to produce, and by means of which life is carried on from year to year. A seed consists essentially of two parts, the embryo and the endosperm. The embryo is a plantlet which develops under proper conditions into a plant similar to the one which produced it. The endosperm, the starchy part, consists of a store of food to nourish the embryo when growth starts. Under the proper conditions of heat, air, and moisture, the seed swells, the root bursts forth and strikes downward to gain support, and a tiny leaf also makes an appearance. While the embryo continues to grow, the amount of starch stored up gradually decreases as it is consumed by the young plant. It thus continues to feed until able to draw its nourishment from the soil. It will thus be seen that the strong early growth of the plant is dependent upon the supply of food material in the seed—but with this we shall deal more fully later.

The seed also is the means by which the qualities or characteristics possessed by the parent plant or its ancestors are transmitted to the plant which it produces. Plants transmit their characters from generation to generation, just as surely as do animals. A bearded variety will produce the bearded character in the progeny, an early ripening variety produces year after year plants that ripen early; a stiff strawed variety has this quality year after year. Heavy yielding plants and varieties in turn produce heavy yielders.

WHY GOOD SEED IS REQUIRED.

To intelligently consider the requisite qualities in good seed, and see clearly how essential it is that improvement be effected, we must understand the uses of the product. It is a matter of general knowledge that our highest grades of spring wheat can be used to produce a flour of unusual strength, but its value is due not so much to this fact, as to its usefulness for mixing wheats of a poorer quality in order to raise the standard of the resultant flour. 'The English miller does not want No. 1 hard for making a purely No. 1 hard wheat flour, but to mix with other sorts to make a standard flour of his own, and so long as No. 1 Canadian wheat is of the very highest milling value, it will command a premium above its real single milling value.'

—'The Miller,' London, Eng. To maintain the present high standard of our milling wheats is therefore essential to continued success, and we should aim to produce twenty-five years from now at least as good a quality of wheat as we are growing to-day.

To succeed in this we must adopt and continue those practices that make for improved quality and increased yield in our crops. We cannot progress without this. Careless methods of cultivation and sowing, invariably result in an increase of weeds, depleted soil fertility and the mixing of varieties. Hence we see deterioration in the quality of crop instead of improvement.

VARIETIES.

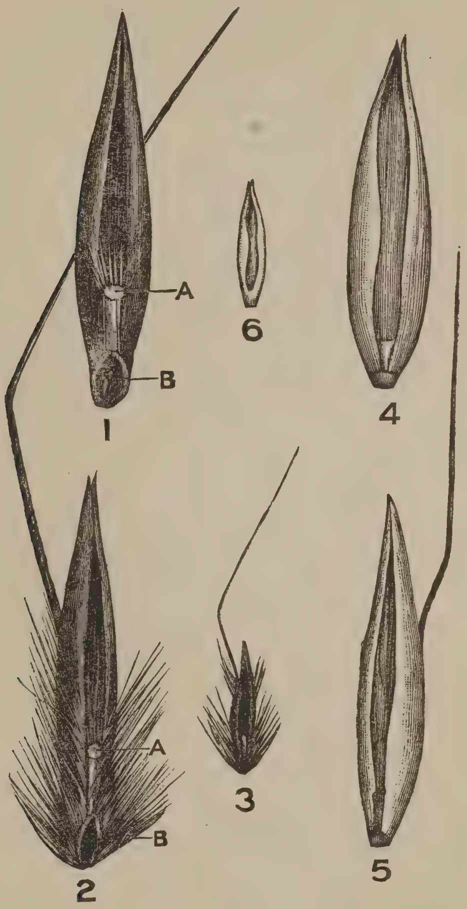
Red Fife wheat has always been and still continues the standard variety of wheat for western conditions. It is a good yielder, produces a stiff strong straw that is not subject to rust, and produces a flour of the highest quality. This variety has greatly aided in giving Canadian hard wheat its enviable reputation on the markets of the world, and at present there is no variety that can be recommended above it for ordinary conditions. Under conditions where Red Fife will not mature before danger of frost, it is advisable to try some of the earlier ripening varieties originated by the experimental farms, and which have proved their adaptability to those conditions. Among those which have given good results in various districts may be mentioned Preston, Huron, Stanley and Percy. These varieties all compare favourably with Red Fife in yield per acre, and also produce a good yield and quality of flour. In some localities the practice of growing earlier ripening varieties is becoming very common regardless of whether they are of good milling quality. This will prove detrimental to the reputation of our wheat just in proportion to the extent to which it is followed.

MIXED VARIETIES.

Uniformity in colour, size, and shape of kernels is one of the first essentials in a high grade of wheat. Different varieties of wheat present marked differences in the appearance of the kernels, and when several varieties are mixed together the resultant sample lacks uniformity. Usually also in a crop mixed in this way some varieties are ripe before others and we therefore find a much greater variation in appearance on this account. The early ripening varieties, (which often are bearded) in such a mixture continue to increase in proportion year after year, on account of shelling more readily and appearing as volunteer wheat the following season. Further, bearded soft strawed varieties of wheat are much more subject to the attacks of rust, and, becoming affected early, spread the disease rapidly to other plants surrounding them. The importance cannot, therefore, be too strongly urged of having, not only the best obtainable variety, but also of having it pure.

WEEDS.

In addition to the harm done by mixtures of this sort, weed seeds are every year the cause of incalculable direct loss. Weeds have been largely introduced through the medium of seed grain, and their rapid distribution through the farming areas is also largely through this medium. When they once get a foothold in a country such as this, where on the majority of farms no regular rotation is followed it becomes difficult to eradicate them. In many of the newer parts immunity from many of the worst weeds is still enjoyed, but not half appreciated. In such cases the utmost care should be taken to prevent their introduction. As an aid in accomplishing this it is important to know the weed seeds. The Wild Oats is one of the worst weeds that the Manitoba farmer has to combat at present, and it has been most commonly introduced through seed grain. It is only necessary to know what the seed looks like to prevent its introduction from such a source, and with many of our other weeds the same is true. It is therefore highly important to be able to identify the seeds of our common weeds.



1. Form of Wild Oat *(Avena fatua)* (enlarged) as it usually occurs as an impurity in grain, the awn and hairy growth being broken off during the process of threshing.
2. Form of Wild Oat (enlarged) as it occurs in nature.
3. Form of Wild Oat (natural size).

4 and 5. Forms of the cultivated oat *(Avena sativa)* (enlarged).

6. Form of the cultivated oat (natural size).

A. Point of attachment of 'bosom' oat. This characteristic in the Wild Oat is seldom present in the 'bosom' grain.

B. A characteristic of all grains of the Wild Oat *(Avena fatua)*.

SIZE OF SEED.

Various experiments have been conducted to determine the relative value of different sizes of seed. At the Indian Head Experimental Farm, Superintendent Angus Mackay, as the average of two years, reports a yield of 49 bushels and 40 lbs. from well cleaned wheat, and only 44 bushels and 30 lbs. from small wheat of the same variety, a difference in favour of the well cleaned seed of over 5 bushels per acre. From well cleaned oats the average yield of two years was 101 bushels and 16 lbs., and from small oats 96 bushels and 11 lbs., a difference of 5 bushels in favour of the large seed. In a similar experiment at Guelph, Ont., Professor Zavitz obtained a difference in yield of 8 bushels per acre between heavy and light oats and of 5 bushels per acre in comparing the yields from heavy wheat with that from shrunken wheat. The results of Professor Zavitz are the average of ten years careful experimenting. These differences of a few bushels per acre may seem small until we consider what they amount to on a large farm, or on the total crop producing area of the North-west. An increase in yield of only one bushel per acre amounts in one year to upwards of 4,000,000 bushels of wheat in Manitoba and Saskatchewan, with a value approximating $3,000,000. *Several times this increase could be derived simply by the sowing of seed that had all the small and shrunken grains cleaned out. The same process of cleaning also insures comparative freedom from weed seeds.*

The extent to which large plump grain will yield heavier than small grain of the same kind, will depend largely upon the season and the condition of the soil. With a favourable season for early growth, and a well prepared seed bed there will be a smaller difference in yields than where the conditions are less favourable for a thrifty well nourished growth. This, which has been found repeatedly and persistently to be the case is due simply to the fact that the plant from the large plump seed being stronger and possessed of more vigour, is better able to withstand adverse conditions than the more weakly plant from the small or shrunken seed.

RIPE AND IMMATURE SEED.

We have little definite information regarding the relative merits of ripe grain and immature grain for seeding purposes. In experimenting with winter wheat Zavitz found that 'seed taken from wheat which was allowed to become very ripe before it was cut produced a greater yield of grain and straw, and a heavier weight of grain per measured bushel than that produced from wheat which was cut at any one of four earlier stages of maturity, according to the average results of fourteen separate tests.' What other figures and facts at hand go to show is that for seeding purposes all classes of grain should be allowed to get thoroughly ripe before being cut. The impression that grain cut before maturing has a tendency to produce an earlier ripening strain has nothing to support it in fact. To get a strain that will ripen earlier, the more rational way would be to select every year that which matures first. Perfectly ripened seed gives a stronger early growth than immature seed.

FROZEN GRAIN FOR SEED.

There is frequently a temptation to sow grain that has been affected by frost. The value of such grain for seed depends entirely upon the degree of the injury. Not infrequently a frost will riffle the bran of wheat of good quality when in stook; as a rule the vitality suffers no injury and the seeding value is not affected. When, however, a frost occurs before the grain has reached maturity the vitality is often seriously impaired, and care is necessary to prevent a disappointing stand. The oat germ is more delicate than that of wheat, and is more likely to be injured by frost. When there is any likelihood that oats have been exposed to frost before being thoroughly ripe, they should be carefully tested before being sown, to determine their value. Wheat shrunken by being frozen when immature should never be sown when good seed can be secured. Such seed has all the disadvantages of small seed, and in addition has a weakened germ that will give a plant lacking strength and vigour. The extent to which this will affect the yield of the resulting crop will depend to a certain extent upon the weather conditions.

SEED FROM A RUSTED CROP.

While we have had only one serious visitation of rust in the wheat growing sections of the west, in all probability it will not be the last. In view of this, and the serious effects of rust on grain crops a few words on rusted seed may not be out of place.

It is now pretty generally understood that rust, (*Puccinia Graminus*), is a fungus disease that develops and lives inside the plant, extracting nourishment from it, checking its normal development. The reddish or black streaks or spots seen on the leaves or stems consist of numberless spores by which the disease reproduces itself. The seeds produced by plants badly affected by rust are shrivelled to a greater or less extent; frequently they are less than half the normal weight. Contrary to what might be expected, such shrivelled seed seldom fails to germinate. But we have already shown that to germinate life is only the beginning of the seed's function, and this being the case, it is quite apparent why seed from a rusted crop does not give satisfactory results. Seed from a plant badly affected by rust is analogous to immature, shrunken seed—it is light in weight, the germ is often weak, and the amount of starch stored up to feed the germ is small.

Carefully conducted experiments by the writer have shown conclusively that plants from seeds shrivelled by rust do not possess the vigour of plants grown from normal seeds, nor can they withstand adverse conditions, such as frost or backward weather nearly so well.

With grain, part of which is from a rusted crop, a good sample for sowing can be obtained by a thorough screening to remove all inferior, shrunken seed. In making such a separation, a start is also being made toward securing a strain of wheat less subject to the attacks of rust. To accomplish much in this direction, however, it is necessary that a selection be made of individual plants that show less liability to disease attacks than others under the same, or similar, conditions. In Australia, where rust is more prevalent than in this country, and where disease resistant strains are therefore of more importance, a fair degree of success has rewarded persistent effort in selecting strains less subject to rust.

THE GROWING OF SEED.

Those phases of the question that we have been dealing with are mainly those that would be taken into consideration in the purchase of seed. But only a very small percentage of the seed used in this country is purchased; by far the larger part is grown on the farm. The purchase of seed is usually confined to comparatively small quantities, an acreage large enough to furnish all the seed required the following year. In growing seed grain there are important points to be borne in mind.

SEED AND SOIL.

A very intimate relation exists between the soil and the quality of seed produced. To grow a plump and vigorous seed necessitates, in the first place, a soil capable of producing a healthy vigorous plant growth. A soil depleted in fertility by continued cropping produces a weak irregular growth, and it is not able to meet the demands made upon it by a heavy feeding crop. From such soil, therefore, we get seed that is lacking in vigour and uniformity. It is a recognized fact that grain deteriorates in quality if grown under unfavourable soil conditions. When carefully grown on fertile well cultivated soil, they frequently become vastly improved in quality and producing capacity. While the cereals are not so amenable to such treatment as some other crops, it is a fact that favourable conditions of growth maintain and improve good qualities in grain crops, while with poor conditions the reverse is the case. Excessively thick seeding is another cause for decreasing vigour in a crop, while crowding with weeds has a similar effect The effects become more apparent when any of the unfavourable conditions of growth are continued for a number of seasons. This is shown very clearly by the results of an experiment conducted by Professor Zavitz in the continued selection of Joanette oats, a prolific black variety. For twelve years in succession an experiment was conducted in breeding oats by means of selection of seed. The selections were large, plump, well developed seed, and a light weight, light coloured, seed. The selection made each year was from the product of the selected seed of the previous year. An equal number of grains was used on each plot each year. *In the crop produced in 1904, the large plump seed yielded 94·1 bushels, weighing 34·5 lbs. per bushel, and the light seed 68 bushels, weighing 24 lbs. to the bushel.* The crop grown from the large plump seed required only 1,390 grains to weigh an ounce, while the crop from the light seed required 2,095 grains. The results of this experiment show conclusively that oats will degenerate if one of the conditions of successful growth, viz., plump, vigorous seed, be absent.

The lack of good soil conditions again, for a number of years, is sufficient in itself to account for marked deterioration in quality of grain. Under such conditions the functions of growth are performed with comparative difficulty and the resultant plant is less vigorous. The amount of crop depends directly upon the amount of plant food that can be obtained from the soil and assimilated. Certain varieties are capable of obtaining more plant food from the soil under certain conditions than are others, and therefore produce more abundant crops. It must therefore be borne in mind that to get the best results from improved varieties and strains, the soil requires to be in such condition as to render available to the crop a larger amount of plant food than when an ordinary variety is to be grown. The practice of growing seed on new land, or land in a good state of cultivation is therefore a most commendable one to follow. New land has the additional advantage of being free from noxious weeds. A soil that is exhausted by frequent cropping should not be used for the production of seed, even though the sample produced may appear acceptable. It lacks those qualities which go farthest to make seed valuable.

As a successful crop of seed grain depends largely upon the quality and condition of the soil upon which it is grown, the most suitable soil should be chosen. From ten to forty acres is sufficient to produce the seed required by the average farmer, and for the production of seed, this should be the best land on the farm. It should be seeded as soon as it can be got in good physical condition, with the best seed available. This involves little or no additional expense and always gives good returns, as the crop produced is more uniform and ripens earlier.

THE AMOUNT OF SEED PER ACRE.

This depends upon various considerations, viz., time of sowing, variety, nature and condition of soil, latitude, and kind of seed. With wheat, it varies from one to two bushels per acre, with oats and barley, from one and a half to two and a half bushels per acre. As a general rule, grain for seed should be sown sufficiently thin to allow the plants ample room for perfect development, bearing in mind that thinly seeded grain stools or tillers readily and therefore ripens more slowly than grain sown more thickly. The later the date of sowing the more seed per acre is required to insure ripening. Excessively rich land, or new land, frequently requires more than the average amount of seed per acre, as the available fertility tends to promote a luxuriant and late growth. Different varieties of grain differ materially in size of kernel and the quantity sown per acre requires to be regulated accordingly, the varieties with a small average kernel requiring somewhat less in bushels per acre than those with a larger kernel.

STACKING VERSUS STOOK THRESHING.

There are various points to be taken into consideration in deciding upon whether to stack or thresh from the stook. In growing seed the plan to follow is the one which will most economically save the grain without weathering it, and with as little risk as possible. Grain badly weathered lacks the vitality of that properly saved. There is too much at stake to run any unnecessary risks, and care should be taken that the grain is perfectly dry before stacking or threshing. Dry storage is equally important, as any dampness whatever has a most injurious effect on the vitality of the seed.

CLEANING.

Figures have already been given to show that large seed will give a greater yield than small seed of the same kind, and that nothing should be sown but large plump seed. Care in cleaning always pays, and the more thoroughly small seed is cleaned out, the better are the results obtained. All grain for seed should be cleaned at least twice. A cleaning machine is to be preferred which has the cleaning action of both a current of air, and screens. Not infrequently large, light seeds are thus eliminated that would be sown if only screens were used.

CHANGING SEED.

Grain that has been grown under the conditions favourable to a healthy vigorous growth, does not deteriorate in quality and may be grown indefinitely on the same farm. When properly cared for it improves in quality and becomes more adapted to the conditions under which it is grown. The changing of seed which is so frequently advocated as a means of improving yields and quality of grain often gives very unsatisfactory results, and is not a practice that, in itself, leads to any permanent improvement. On the contrary, it is a fertile source for the introduction of weeds, and in that respect is a most iniquitous practice. A change of seed is advisable, and is productive of good results when a better quality of seed is obtained. When conditions are such that a crop can be grown to a perfect degree of development there is no excuse for changing seed. If, however, the conditions obtaining on a neighbouring farm are those under which a certain crop makes a more satisfactory growth, it is good policy to secure seed grown under such conditions.

HAND SELECTION OF SEED.

Instead of changing seed with the object of keeping up and improving the yield and quality, an intelligent selection of seed from year to year is recommended. Any careful observer will have noticed that different plants of the same variety differ in the size and number of heads they produce, and in their yield of grain. This is due sometimes to their being under slightly different conditions, one plant having a greater food supply than another, and to the difference in their inherent power to produce. Some plants are capable of yielding 20 per cent more than others under the same conditions, and we should aim to produce strains from the plants which are capable of a uniformly high yield. To a certain extent this has been done successfully with all kinds of grain crops, and the field for further improvement is still unlimited. An increased power to yield only one bushel more per acre, which is a small gain, amounts, in one season, with the present crop acreage in Manitoba, Saskatchewan and Alberta, to an aggregate of about 6,000,000 bushels increased production of grain. There are strains of the standard varieties that differ widely in their capacity to yield, and this is due largely to the system of growing and selection that has been followed from year to year. Some such strains have a pedigree just as truly as have many of the strains of live stock. But just as families and strains of the same breed of live stock differ in value according to the conditions under which they are produced, the skill of the breeder, and his chief object in view; so do strains of varieties of grains differ according to the skill of the operator, the conditions under which he worked, and the type towards which he selected. The importance of having a type firmly fixed and constantly in mind cannot, therefore, be too strongly emphasized where permanent benefit is sought.*

On account of the skill, the time, and the labour involved in the work of improving crops by hand selection, it is a system that cannot profitably be followed by every farmer. Few men have an aptitude for such work, and some of these are so situated that a lack of labour precludes the possibility of tneir pursuing it successfully. This work can most satisfactorily and cheaply be done by these making a specialty of it. We find a comparatively few breeders and improvers of live stock but their work is beneficial to all other farmers and a ready market at remunerative prices is found for pure bred stock. In the improvement of grains we will get the best results where somewhat similar conditions obtain; where one farmer on a clean, well cultivated farm can supply twenty or thirty others with improved seed, at a reasonable advance in price over the market to pay for the additional cost in production.

TREATING FOR SMUT.

Smut is a fungus disease which attacks the different cereals more or less every year, with the frequent result that the yield is reduced, the market value lessened, and considerable loss thus incurred. The disease, which is reproduced by spores, attacks the plants when they are only a few days old, through the spores being attached to the seed. Various remedies have been discovered, and as they are inexpensive, it is advisable, every year, to guard against the effect of this disease by treating the seed. To prevent smut on wheat, bluestone (copper sulphate) has been found to answer admirably, in that it is easily applied and effectual in destroying the spores. The best results are got by immersing the wheat for a few minutes in a solution of bluestone, using one pound to from five to ten bushels of grain according to how badly it is affected. Sprinkling, if thoroughly done, is quite as efficacious as dipping, if care be taken that every grain is wet.

To prevent smut on oats and barley, formalin, (a 40 per cent solution of formaldehyde) gives best results. One pound of formalin is sufficient for fifty bushels of seed, except where much smut is present, when rather more should be used. With formalin, as with bluestone, soaking will usually give best results.

In all cases grain should be sown as soon as it can be dried after treatment. When sown immediately no damage results from the effects of the solution of the germ. If, however, it is allowed to stand for any considerable length of time after drying, a percentage of the grain will not grow; the amount varying with the length of time before sowing, and the strength of the solution.

TESTING SEEDS.

The testing of seeds for vitality has not received the attention it merits at the hands of those to whom it is of the greatest benefit. No matter what other good qualities a seed may have, if it does not contain a living germ it fails utterly in its purpose. No amount of experience in judging from external appearances can enable one to say definitely whether the germ of a seed is living or dead; it can be determined accurately only by putting it under conditions that are favourable for growth. Poor germinating capacity may be due to several causes. When a seed is fresh, the germ usually starts to grow as soon as the conditions necessary for growth, viz., a sufficient supply of moisture, heat and air are supplied. But as they get older, they gradually lose their ability to grow and finally die completely. The length of time that they retain vitality varies with different kinds of seeds and depends upon the manner in which they are preserved, and their condition when stored. Cereal seeds gradually lose their vitality after the second year, and when ten years old will usually fail to germinate. A moist or musty condition in the store room is fatal to the vitality of the germ. Frost, injury during threshing, treatment with chemicals, all have an effect on the vitality of seeds. Where there is any doubt as to the vitality, it should be tested before sowing. To make a test of cereal seeds, one hundred seeds are required for a single test, and these should be selected to secure a representative sample. They should be put half an inch, or one inch deep in ordinary soil, and kept damp, and at the temperature of an ordinary living room. All the seeds which have a living germ should germinate under these conditions, and send up a leaf blade. After ten or twelve days the number of plants may be counted, and the value of the seed thus ascertained. If soil is not available, the seeds may be placed between layers of damp flannel or blotting paper, in a dinner plate with another plate inverted over this to keep in the moisture. The number of seeds which germinate may be counted from day to day. A good sample of seeds should not only have a large number of seeds capable of growing, but they should start quickly to grow and send out strong sprouts. Seeds which lie several days before sprouting are not as desirable as those which germinate sooner. A rapid uniform growth of at least 90 per cent is required in a first class sample of seed from any of the grains.

---

* Further information regarding the selection of seed, and the registering of selected seed may be obtained from the secretary of the Canadian Seed Growers' Association, Ottawa, Ont.

SUMMARY.

1. A good beginning is essential. The seed is the starting point of all successful crops. This is one of the few factors in crop growth that is controllable.

2. Grow only good milling varieties, pure and clean.

3. Grow your own seed. Changing seed is poor policy. Avoid the danger of introducing weeds. Change only when a *better* quality of *clean* seed is obtainable.

4. Good cultivation and productive soil are essentials in the growing of the best seed. Set apart a few acres of the cleanest and best land every year on which to grow seed. Sow as early as the land is fit. Allow it to mature perfectly. Thresh and store when thoroughly dry.

5. All seed should be thoroughly cleaned to remove weed seeds and all small grains. Once through a mill may not be enough.

6. Hand selection is a good way to keep varieties pure, to improve quality, and increase yield.

7. Smut can be prevented by treating the seed.

8. Prove the vitality of your seed by testing.

630.14
C16
no.S3

DOMINION OF CANADA DEPARTMENT OF AGRICULTURE.

SEED BRANCH.

GEO. H. CLARK, *Seed Commissioner.*

Bunt, or the Stinking Smut of Wheat.

Part I.—Life History and Methods of Treatment;
Part II.—A Summary of Investigations.

BY

J. HORACE FAULL, B.A., Ph.D.,
LECTURER IN BOTANY, UNIVERSITY OF TORONTO

Bulletin S. 3.

Published by direction of the HON. SYDNEY A. FISHER, Minister of Agriculture,
OTTAWA, FEBRUARY 12TH, 1907.

630.14
C16
no. S3

DOMINION OF CANADA DEPARTMENT OF AGRICULTURE

SEED BRANCH.

GEO. H. CLARK, *Seed Commissioner.*

Bunt, or the Stinking Smut of Wheat.

Part I.—Life History and Methods of Treatment; Part II.—A Summary of Investigations.

BY

J. HORACE FAULL, B.A., Ph.D.,
Lecturer in Botany, University of Toronto.

Bulletin S. 3.

Published by direction of the Hon. SYDNEY A. FISHER, Minister of Agriculture,
Ottawa, February 12th, 1907.

DEPARTMENT OF AGRICULTURE,
OFFICE OF SEED COMMISSIONER.

OTTAWA, CANADA, February 12, 1907.

HONOURABLE SYDNEY A. FISHER,
Minister of Agriculture,
Ottawa.

SIR,—I beg to transmit herewith a treatise on the stinking smut of wheat, prepared by J. Horace Faull, B.A., Ph.D., Lecturer in Botany in the University of Toronto. Dr. Faull has spent considerable time in the wheat fields of Western Canada and in laboratory work in a special study of the causes of stinking smut in wheat and in methods of controlling and eradicating it. The treatise contains a summary of the results of his investigations. The information contained therein will be of much value to farmers, particularly those located in the wheat belt in western Canada. I recommend that it be printed in bulletin form for distribution.

I have the honour to be, Sir,

Your obedient servant,

GEO. H. CLARK,
Seed Commissioner.

BUNT, OR THE STINKING SMUT OF WHEAT.

Part I.—Life History and Methods of Treatment.

Bunt, or the stinking smut of wheat, is a lowly form of plant life that lives as a parasite in the growing wheat. During the summer it consists of branched, jointed threads, not unlike certain moulds, and so fine as not to be seen by the unaided eye. While the wheat is heading, these threads grow up into the young grains, usually filling them with a dense mass. Some of the joints of this mass then swell up, blacken, and separate from one another. In fact, they are transformed into the brownish black powder or *spores* that fill the smut balls.

These spores are known to retain life in the granary for at least seven years, and in the soil for two years. Under favorable conditions they are capable of germinating in the soil, quite independently of the grain, and of producing crops of a second and of even a third type of spores that are equally virulent.

Each spore is capable of infecting a seedling up to the time that the first leaf shows itself above the ground. The conditions most favorable to its growth would appear to be those most favorable to the growth of the grain. It is asserted, however, that sowing at a uniform depth as shallow as practicable, gives the wheat the best chance. In fact, the conditions of the seed, the soil, and the climate, and the depth of sowing, which favor the rapid and healthy growth of the young plant from the time of germination until the green leaf is well developed, serve to minimize the dangers of infection.

The spores that adhere to the surface of the wheat at the time it is sown are the principal source of infection. Fortunately any one of several methods may be adopted for killing them without killing the seed, and since the disease is so prevalent and so easily transmitted, it would seem advisable that some method of treatment should be applied to all seed every year.

METHODS OF TREATMENT.

Formalin :

Use one full pound of formalin in every forty gallons of water and proceed as follows :—

If the seed is from a smutted crop, immerse in the solution, stir thoroughly, and skim off the smut balls. Leave the seed in the solution for two hours before taking it out to dry. Or remove the seed from the solution at the end of fifteen minutes, pile, and cover closely with canvas or sacking to keep in the fumes of the formalin. Leave in the pile for two hours and then spread out to aerate. Sow as soon as possible.

If the seed is from an unsmutted crop, wet the seed thoroughly with the solution, pile, and cover with canvas or sacking. Leave the grain in the pile for two hours, then aerate.

Formalin is a forty per cent. solution of formaldehyde, and this strength should be guaranteed to the purchaser.

Copper Sulphate (bluestone):

Dissolve one pound of copper sulphate in twenty gallons of soft water. Immerse the grain for about twelve hours, stirring occasionally. Then spread out in a thin layer and dry rapidly. Sow as soon as possible.

The purest copper sulphate is sold in the form of crystals. These are readily dissolved in a small quantity of hot water.

After removing from the solution, some recommend an immersion of the grain for five minutes in lime water, made by putting one pound of good lime into ten gallons of water.

PRECAUTIONS.

1. Take particular care to guard against living spores falling on the seed or coming into contact with it after treatment, otherwise all the labour of treatment may be in vain. Smut spores are produced at the enormous rate of two to five millions in every smut ball; they are extremely light, and are easily carried by air currents. If the seed is dried on a floor, the floor must first be washed with a solution of one pound of copper sulphate to ten gallons of water; if on a canvas, the canvas must first be dipped into boiling water. Likewise, dip the sacks into boiling water, and dry before filling them with the treated seed.

2. Use vigorous seed. Immature, shrunken seed, or seed enfeebled by disease or age suffers from treatment, and their seedlings are more susceptible to infection from smut than those from strong seed.

3. Remove all smut balls from the seed. The spores contained by them are not killed by practicable methods of treatment.

4. It is necessary to sow a somewhat larger quantity of treated seed per acre than of untreated. Allowance must be made for the swelling of the grain, and for a certain proportion killed by the solution used.

5. Sow as soon after treatment as is practicable.

6. Dry rapidly. Plan the time of treatment, so that the drying will begin early in the day. Then spread out the grain on the floor or in the sun on canvas sheets (sterilized as indicated in precaution 1) in a layer not more than three inches deep, and shovel over frequently.

In conclusion, there can be no question as to the desirability of maintaining a breeding plot for hand selected seed[1] on every farm. Their adoption would result in an increased yield, improved seed, uniform and pure stock, and would go far towards the solution of the smut problem, especially if there were persistence in careful, scientific treatment of the seed before sowing.

Part II.—A Summary of Investigations.

For many years agriculturists have made a practice of treating seed wheat for smut, with the result that there has been a diminution of this pest. But it has not been eradicated. Indeed, it has been estimated that for the last few years six per cent. of the crop of Western Canada that has been officially inspected has been rejected on account of smut, and this represents a part only of the loss from this cause.

Through the generosity of the Governors of the University of Toronto and the western railway companies, I was enabled, in response to a request to investigate the smut problem, to visit several places in Southern Manitoba, Saskatchewan, and Southern Alberta.

Material has been very kindly supplied to me by Messrs. D. D. Campbell of Winnipeg, Angus McKay of Indian Head, and John A. Mooney of Valley River, Manitoba, and from Ontario, through the office of the Field Experimentalist. Mr. G. H. Clark, the Dominion Seed Commissioner, has co-operated at every stage of the investigation, and has very graciously placed his seed laboratory at my disposal, and his practical knowledge of agriculture and the conditions in Western Canada.

Two species of stinking smut (*Tilletia foetens*, (B & C), Trel., and *Tilletia tritici* (Bjerk) Wint.), attack the wheat, both spring and fall, throughout Canada. *T. tritici* (Bjerk) Wint. is much more prevalent than has been heretofore supposed, in some places distinctly predominating.

---

[1] Directions for conducting these plots are printed and supplied free of charge by the Seed Commissioner, Department of Agriculture, Ottawa.

In attempting to germinate their spores, several kinds of nutrient media were tried. None gave better results than a sterilized decoction of virgin prairie soil, maintained at a temperature of about 60° Fahrenheit, and this medium was used throughout.

The problem in hand has been attacked from several standpoints, an outline of which, with some results, is as follows :—

I. TO DETERMINE THE EFFICIENCY OF VARIOUS SOLUTIONS IN KILLING SPORES IN UNBROKEN SMUT BALLS.

Upwards of one hundred tests were made with solutions of copper sulphate varying in strength from one pound in one gallon of water to one pound in twenty-five gallons, and for periods varying from one minute to twenty-four hours; and seventy-five tests with formalin for periods varying from one hour to four hours. In every case the smut balls were immersed in the solutions.

The following is an extract from the record of data obtained.

Strength of Solution.	Length of Treatment.	Per cent. of Smut Balls containing living spores after treatment.
Copper Sulphate :		
1 lb.—1 gal............	20 minutes.	60
1 lb.—2½ gal............	1 hour.	33.
1 lb.—5 gal.	1 hour.	80
1 lb.—10 gal...........	1 hour.	100
1 lb.—20 gal...........	12 hours.	33.
Formalin :		
1 lb.—50 gal...........	3¼ hours.	100.
1 lb.—60 gal	3¼ hours.	100.
1 lb.—40 gal............	4 hours.	33.

In all of the formalin and a few of the copper sulphate tests, the spores were taken from directly under the covering of the smut ball, proving that the smut ball is very impervious to penetration by a liquid.

From the foregoing table it will be seen that the vitality of all the spores contained in smut balls cannot be destroyed by practicable methods of treatment. Since smut balls that are left in the seed wheat are apt to become broken when passing through the seeder, recontaminating treated seed, it is therefore always advisable to get rid of them before sowing. This may be done by immersing the seed in barrels or tanks, made for the purpose, to such a depth that all the smut balls may be floated, skimmed off, and destroyed.

II. TO DETERMINE THE EFFICIENCY OF VARIOUS SOLUTIONS IN KILLING THE SPORES THAT ADHERE TO THE SURFACE OF SOUND GRAINS.

Four lots of smutted grain were respectively treated with the following solutions for a limited number of different periods of time :—One pound of copper sulphate to ten gallons of water, and one pound to twenty gallons ; one pound of formalin to forty gallons of water, and one pound to fifty gallons.

Forty grains were then selected, and scrapings were made from the grooves and placed in germinators.

Scrapings from half of the grains treated with the copper sulphate solutions contained living spores after treatment for one, five, twenty, and thirty minutes repectively, and in one case for one hour, but none for longer periods, and with the formalin solutions for one and five minutes respectively, and none for longer periods.

The efficiency of any treatment of smutted seed with copper sulphate or formalin for less than one hour may therefore be reasonably questioned.

In this connection, an extract from the report of the Dominion Experimental Farms for 1900 is especially pertinent. Mr. Angus McKay—"The seed used in this test was considerably affected with smut, and the result of the test indicates that to be entirely effectual the solution of formalin should be applied to the seed for at least one hour." There were no smutted heads in the crop.

The results of experiments with Doncaster Prize Oats carried on by Mr. R. Robertson, Nappan, (1899 Reports) are strikingly significant in comparison with the results in germinating smut spores recorded in this bulletin. Mr. Robertson treated with a solution of formalin, one pound to 35½ gallons of water.

Time.	Good Heads.	Smutted Heads.
Soaked 1 hour	2814.	None.
Soaked 15 minutes	3354.	36.
Soaked 5 minutes	3480.	360.
Sprinkled	3060.	342.
Untreated	2784.	996.

The serious difficulty encountered in treating seed grain for a short period of time, for example, by the use of smut machines, by the sprinkling process, or even by dipping for a short time, is in bringing the solution into contact with every smut spore. The groove on the face of the grain is often deep or narrow, and sometimes there are cracks in the seed coat. Air bubbles are almost certain to form at first over these grooves and cracks with the result that many smut spores are not wetted by the solution and hence are undestroyed, if the treatment is too rapid. In this investigation comparatively large quantities of seed were used in order more accurately to duplicate the methods of treatment used in general practice. The results of the work throughout make clear that a solution consisting of 1 lb. of formalin to 40 gallons, or 1 lb. of copper sulphate to 20 gallons of soft water is sufficiently strong to kill any smut spore that is wetted by it. A stronger solution could not be more effective in killing smut spores, and is especially undesirable because it does increased and unnecessary injury to the seed wheat by killing from ten to fifty per cent. of it and greatly weakening the rest of the seed.

III. TO DETERMINE THE EFFECT OF TREATMENT ON THE VITALITY OF THE SEED.

Two sets of experiments were made, one with western grown No. 1 Northern, purchased from the Brown Milling Co., of Toronto, and said to be of this year's crop, and the second with wheat contributed by Mr. J. A. Mooney, of Valley River, Manitoba, from his seed plot, likewise from the harvest of 1906.

More than three hundred separate tests were made with the first set, and more than one hundred with the second. The germination tests were conducted by a Swiss seed specialist, and in standard seed germinators.

The following percentages of viable grains that germinated after treatment are worthy of study and comparison.

FORMALIN.

No. 1 Northern purchased in Toronto:

—	1 hr.	2 hrs.	3 hrs.	6 hrs.
1 lb.—30 gal.........	86%	45%	28%	13%
1 lb.—40 gal.........	91%	80%	78%	48%
1 lb.—50 gal.........	95%	86%	83%	79%

Mooney's Wheat:

—	1 hr.	2 hrs.	3 hrs.	4 hrs.	6 hrs.
1 lb.—30 gal............	100%	No tests made.			
1 lb.—40 gal............	100%	100%	100%	100%	100%
1 lb.—50 gal............	100%	100%	100%	100%	100%

COPPER SULPHATE.

No. 1 Northern.—Rather more severe than with formalin.

Mooney's Wheat:

—	1 hr.	3 hrs.	6 hrs.	12 hrs.	18 hrs.
1 lb.—10 gal.	100%				
1 lb.—15 gal.	100%	100%	100%	98%	100%
1 lb.—20 gal.	100%	100%	100%	99%	100%

The differences in the results can be accounted for in a number of ways.

(1) The Mooney wheat was dried more quickly after treatment; there were no cracked grains; *it was a selected wheat of known pedigree.*

(2) The No. 1 Northern was threshed by machine and contained some checked grains; it was not a pure variety, and there is no absolute certainty that it came from the 1906 crop.

(3) There may have been a difference in the stage of maturity of the two lots of grain when harvested—certainly not a negligible factor in its bearing on the vitality of the seed.

Professor Shutt of the Central Experimental Farm has convincingly demonstrated that seed of weak vital energy suffers most from treatment.

In addition to the foregoing, abundant data have been obtained bearing on the question of the weakening of the vital energy of those grains that are not killed by treatment. The more severe the treatment, within certain limits, the greater is the delay in the germination of the seed. But this is far more striking with the copper sulphate than with the formalin. Indeed, the formalin is ordinarily not objectionable on these grounds.

In regard to the continuous effects of treatment on seed that is not sown at once, Dr. Chas. E. Saunders, crealist, has presented some interesting statistics. Germination tests made by him immediately after, and eleven months after treatment, conclusively proved the possibility of disastrous results when sowing is delayed.

If the soil conditions are such at the time of sowing that there is likely to be a delay in germination, it is beneficial to wash the seed in water after taking it out of the solution, or in lime water if copper sulphate has been used.

A comparison of the effects of treating different varieties of wheat in the same way is important. Professor Shutt and others have shown that there is a marked difference. None has proved to be more resistant and better able to endure treatment than Red Fife.

In conclusion, fresh, vigorous seed, from healthy plants harvested at full maturity, dried quickly after treatment, and sown at once, will sustain little injury from the methods of treatment advised in this bulletin.

IV. TO DETERMINE THE POSSIBILITY OF INFECTION FROM SPORES CARRIED IN THE SOIL.

Mr. G. H. Clark took the pains to make somewhat extensive observations on this matter during the last summer. The parts of the fields over which clouds of the spores were carried during the previous year's threshing operations were carefully compared with the surrounding parts. I can corroborate his conclusion, which is in harmony with that of the veteran botanist Brefeld, that soil infection does play a part, but I am not in a position to state how significant a part this may be.

The spores blown from the threshing-machine are sometimes carried for miles. Many of them fall to the ground, and may spread the infection; others fall on unthreshed grain—these are the ones that are certain to give trouble.

V. TO DETERMINE IF APPARENTLY SOUND GRAINS MAY BE DISEASED WITH SMUT.

It is commonly asserted that the "whole head if smutted, contains no sound grain, only smutted kernels." Failing to find any statistics on this point, I have given the matter some attention and have arrived a different conclusion.

Smutted heads were gathered in the neighbourhood of Indian Head and carefully threshed by hand. Out of a yield of 1,638 grains, there were 1,444 smut balls or 88.12 per cent., and 194 "sound" grains (viable) or 11.84 per cent. of the whole.

Near Pincher Creek, in Southern Alberta, 11,607 grains were harvested from a collection of diseased plants of which 2,191 or 18.88 per cent. were apparently sound.

At Creelman, Saskatchewan, 54 diseased plants bore 146 heads. Of these heads, 88 or 60.27 per cent. bore nothing but smut balls; 16 or 10.52 per cent. nothing but sound grains, and 42 or 28.77 per cent. both smut balls and "sound" grains. That is, of the smutted heads, nearly one-third contained "sound" grains.

It is known that every stalk of a diseased plant is affected. Commonly, as in the Creelman plants, most of the heads carry smut balls, but frequently there are some that do not, and occasionally the entire plant, though diseased, may be free from them. One might very reasonably suspect, therefore, that the apparently sound grains in these plants are not in reality sound—existing statements to the contrary—and further, that they might insidiously transmit the smut disease to the seedlings which spring from them. If so, very obvious limitations surround the choice of an adequate method of treatment.

A thorough search has resulted in the discovery of spores, and other noteworthy indications of the parasite in a significant number of these suspected grains. This fact alone may account for the prevalence of smut in the fields of many wheat-growers who treat their seed before sowing. If so, the hope of prevention lies in the use of a weak solution for a more prolonged period of time. Here, as with the conditions noted in Section II., hasty methods of treatment cannot be completely effective, especially if the seed has been taken from a smutted crop.

3 0112 072816421

630.14
C16
no. S4

DOMINION OF CANADA - - - DEPARTMENT OF AGRICULTURE

SEED BRANCH

GEO. H. CLARK, Seed Commissioner.

Seed Corn, Field Root and Garden Seeds

SEED TRADE INVESTIGATION.

BULLETIN S. 4

Printed by direction of the Honourable SYDNEY A. FISHER, Minister of Agriculture
Ottawa, February, 1908

DOMINION OF CANADA - - - DEPARTMENT OF AGRICULTURE

SEED BRANCH

GEO. H. CLARK, Seed Commissioner.

Seed Corn, Field Root and Garden Seeds

SEED TRADE INVESTIGATION

BULLETIN S. 4

Printed by direction of the Honourable SYDNEY A. FISHER, Minister of Agriculture
Ottawa, February, 1908

630.4
C16
no. S-4

DOMINION OF CANADA - - DEPARTMENT OF AGRICULTURE

SEED BRANCH

OTTAWA, CANADA.

STAFF OFFICERS.

GEO. H. CLARK,	Seed Commissioner and Official Seed Analyst.
GEO. MICHAUD,	Assistant Seed Analyst, Ottawa Seed Laboratory.
JAMES HAYES,	Assistant Seed Analyst, Calgary Seed Laboratory.

DISTRICT OFFICERS AND SEED INSPECTORS.

W. C. McKILLICAN, B.S.A.,	Calgary, for British Columbia and Alberta.
HARRIS McFADDEN, B.S.A.	Regina, for Saskatchewan.
E. D. EDDY, B.S.A.,	Edward's Block, Winnipeg, for Manitoba.
T. G. RAYNOR, B.S.A.,	Ottawa, for Ontario.
J. C. COTÉ,	Ottawa, for Quebec.
S. J. MOORE,	Truro, for Maritime Provinces.

SEED TRADE INVESTIGATION.

SEED CORN, FIELD ROOT AND GARDEN SEEDS.

In presenting the results of these investigations into the condition of the trade in seed corn, field root and garden seeds, the writer desires to make clear that the facilities now available to the Seed Branch do not permit of extending the scope of such work beyond testing the percentage vitality of seeds. Extensive growing tests are necessary to determine whether the seeds are true to name and to what extent, and by whom variety names are coined and applied to seed of old standard sorts. The staff of the Seed Branch has not been able thus far to undertake such growing tests. From careful inquiry and data compiled from the records of similar investigations conducted by seed control stations in other countries, it would seem entirely reasonable to conclude that the seedsmen of Canada are, as a class, as honourable and reliable as are those of any other country.

It is not always just to condemn the seedsman for having supplied his customers with certain kinds or varieties of seeds that possess a comparatively low percentage of vitality; he may do so much to their advantage and protection.

IMPORTANCE OF VITALITY.

The percentage of vitality is only one of the several qualities possessed by seeds. It is equally important that seeds procured for planting be true to the desired type, and saved from parent crops that have been free from disease and had good care and selection during several preceding years; also that the climatic and other conditions under which seeds were grown be not too dissimilar to those where they are intended for use.

SOURCES OF SUPPLY.

Many kinds of cultivated plants had their origin and are indigenous in their wild state to Southern Europe. Others have been traced back to Asia. Comparatively few are natives of America.

It would seem that the seed of many cultivated crops can be produced to the maximum perfection and with a minimum danger of seed crop failure in those countries and districts where the plant will thrive best in its wild state.

Canadian seedsmen are not as a rule extensive growers and could more properly be termed *seed merchants;* a few of them have their supplies grown on contract. Indian corn, peas and beans are the principal garden crops grown for seed in Canada.

France is sometimes said to be the seed garden of the world. She has earned this enviable reputation and acquired that important industry through having a climate specially favourable for growing seeds of most kinds of crops that are cultivated in our temperate climate and through the intelligent application of the principles of plant improvement by those of her people who make their living by growing and selecting seed for commerce. Other countries that largely contribute to the supply of field root and garden seeds are England, Germany, Holland, Denmark and the United States.

In some years there is a partial or complete failure at the most desirable sources of supply of the seed of garden peas; in other years the difficulty may be with radish, cauliflower, parsnip, turnip, onion, carrot, celery, melon, sweet corn, or what not. At times of such shortage at the desirable sources of supply there is very often abundant supplies offered at the usual price from other though questionable sources.

Responsible seedsmen abroad are usually able to supply the Canadian importers with authentic and selected stocks of seeds at prices commensurate with the cost of production. The Canadian farmers and gardeners who want cheap seeds of an inferior quality can be assured of a continual supply that is expensive at any price; for in the different countries where these supplies are grown, there are to be found irresponsible people engaged in the growing and marketing of seeds.

The question as to the advantages that would accrue to our farmers and gardeners were they able to procure supplies of home grown acclimatized seeds has long been a moot one. There is very good evidence to show that, with proper care, seed of excellent quality of most kinds of field root and garden crops can be grown in Canada. It is claimed too, and there is no evidence to the contrary, that the yield and quality of the turnip, mangel, carrot and other crops from home grown selected seeds are superior to that from imported seeds. There is much need of results from careful experiments to demonstrate whether those claims are well founded.

The expense for labour necessary to the production of many kinds of field root and garden seeds, in a climate like that of Canada, may virtually prohibit the production of the home grown article until such time as farmers and gardeners may learn their increased value to them and are willing to pay a price for them quite double of that which is usually charged for the imported stocks. Much of the biennial field root and garden seeds that enter into commerce is grown under climatic conditions that do not make it necessary to house or otherwise protect the crops during the winter season. The labour required to harvest and store the mother plants in the autumn and transplant them in the spring adds much to the cost of producing field root seeds in Canada.

To acquire an accurate knowledge of the best sources of supply requires years of experience in the seed business and a large expenditure of time and money. The mass of information thus obtained is a valued asset to any established seed house.

THE DISTRIBUTION OF SEED.

The great bulk of our field root and garden seeds is distributed by the importers who are conducting the larger wholesale seed houses; the most of the field root seeds are sold by them in bulk to retail vendors. During the last few years some of the seed houses have adopted the practice of putting up their best selected stocks of turnip, mangel, carrot and other seeds, in "carton" packets, sealed by them, which are put up on the retail market at a price slightly in advance of the article sold in bulk. They are constantly in danger of competition from their less scrupulous competitors who may adopt the same plan and the same variety names in the sale of cheaper seed.

Garden seeds may at any time be had from bulk lots in any of the larger seed houses and are usually obtained in that way by market gardeners or others who use any considerable quantity of them. Supplies of seeds for smaller or kitchen gardens are commonly obtained from what is known in the trade as "papered seeds." These papered seeds are to be seen during the spring months in most grocer, druggist, flour and feed stores, and other places of business that are frequented by farmers and gardeners. The seeds are put up in sealed packets bearing a cut of the plant, the name of the wholesale firm which put up the seed, the name of the kind and variety of seed, and usually some information in concise form as to the best method of cultivating it. The packets are systematically arranged in convenient and attractive show cases before they leave the seed house.

Some of the wholesale merchants have these cases, together with their contents which have remained unsold at the end of the season, returned to them. Each packet bears a mark from which they are able to identify the stock from which it was filled; they know its age and from that knowledge are able to form an opinion as to its vitality and value for future use. All our seedsmen who put up papered seeds do not go to the expense of having the seeds remaining unsold by the retail vendor returned to them at the end of the season, consequently, they are able to offer opportunities to make larger margins for profit to the retail merchants, most of whom have little or no knowledge of the fact that some kinds of seeds (parsnips for instance) are practically worthless if more than a year old, other kinds not reliable when more than two years old, and that some seeds are satisfactory even when five or six years old.*

By having those packets which remain unsold returned to them at the end of the season, examined and tested for germination, they are able to protect their reputation and see to it that their customers are in very little danger of obtaining from their show cases seeds that are worthless.

The results of investigation work with *papered seeds* during the last five years make clear that the system has proven to be in the best interests of the smaller seed purchasers who do not obtain their supplies direct from competent seed merchants. To extend that system to the trade in field root seeds would add materially to their expense to the farmer, but it would do much to abridge the danger to him of obtaining supplies that have become weakened in vitality through age or improper storage.

STORAGE OF SEEDS.

The storage of practically all kinds of seeds of cultivated plants should be in a cool, dry place. The seed is valuable because of the life that is preserved by it, yet many merchants who retail a few kinds of seeds, but whose main business is of an entirely different character, unwittingly expose their supplies of seeds to conditions that are disastrous to their vitality. It is very common to see show cases of garden seeds and bulk lots of field root seeds exposed to the drying heat of the spring sun, intensified by the glass in the show window. Supplies remaining unsold are often stored during the summer months in places most convenient to the retail merchant without due consideration being given to the preservation of the vitality of the seed.

ABOUT GUARANTEE OF QUALITY.

Urgent appeals have frequently been received from seed users for some measure that would require seed merchants to guarantee the percentage of vitality of the seeds they supply. The enactment and strict observance of such a law would doubtless do much to minimize the losses, which in the aggregate for all Canada are large enough, that result from using seed of low percentage of vitality; but, for reasons already explained, improvement in that respect would doubtless result in a sacrifice in the quality of those crops for which seed of low vitality is, in some years, supplied by the best seed houses. If our seedsmen would volunteer correct information as to the origin of growth and selection of their field root and garden seeds, and have that information printed on their packages, farmers and gardeners would better appreciate after a few years trial, that high percentage of vitality in seeds is a quality of secondary consideration. They will do well to continue to estimate to the best of their ability the extent to which their seedsmen value their reputation before purchasing their supplies, and procure their seeds sufficiently early to make a test and secure accurate information for themselves, before planting, as to the percentage of vitality; they can then make allowance for deficiency in vitality and thus insure a satisfactory crop. In any case, the cost of the seed when compared with the other expenses or the value of the resultant crop is very small, even though a double quantity of seed that would germinate only 50% has to be used. However, when the percentage of vitality of seeds falls below two-thirds of the standard of vitality for good seed, the seed merchant who is responsible is deserving of censure, unless purchasers are clearly informed about that weakness in the seed.

---

*Samples of seed have been procured by the Seed Branch that remained in the hands of the retail vendors over winter, which were absolutely worthless for the purpose of seeding.

All good seedsmen know the per cent of vitality of the seeds they have for sale and many of them have signified their willingness to furnish that information to their customers when it has been asked for. Were they able to control the soil conditions, the weather, planting and cultivation, they might be disposed to guarantee a good crop, but not otherwise. It is entirely reasonable to expect seedsmen to provide information as to the percentage vitality of the seeds they offer for sale.

THE NON-WARRANTY CLAUSE.

All seed users are familiar with the non-warranty clause used by seedsmen, printed in their catalogues, on their order forms, invoices and elsewhere.

Seedsmen consider the use of such a clause necessary to protect themselves against crop losses caused by freak growths or by bad methods of cultivation on the part of the purchasers of their seeds; for such losses they cannot be expected to assume any responsibility. When, however, the non-warranty clause is expected to serve as a protection in the sale of seed that is not true to kind and has not had reasonably good care in its selection and growth or will not give a fair germination, it becomes a danger to farmers and gardeners, and tends to stifle progress and encourage careless and unscrupulous practices on the part of the seed merchant.

Our seedsmen have little need of the protection afforded by the non-warranty clause, as far as the genuineness of the seeds they procure from reliable seed growers is concerned.

THE REPUTATION OF A SEED HOUSE.

There are few business interests in which a good reputation is so valued an asset as in the seed business.

It is usual for the larger seed houses to make provision in advance for their supplies of the various kinds, varieties and selected strains of the seeds they have to import. In doing that they have to estimate the requirements of the trade, both in the matter of quantity and quality. To obtain seed of authentic stocks and the best selected strains, a high price has to be paid to the European or other grower. It is known by the Canadian merchant that this seed will produce a highly satisfactory and uniformly good crop, but he also knows that few Canadian seed users have come fully to appreciate the advantages from using such high class seed, and that it would have to be sold in competition with the cheaper stocks.

The principal inducement to the seed merchant to buy this high class seed is the matter of building up the reputation of his business. The problem that usually confronts good seedsmen is: To what extent dare we risk our reputation by dabbling in seeds of questionable stock, and would it not be safer for our firm to use the seed that we know to be genuine though it be lacking in vitality through a ge or other causes?

Few of the seed users may have knowledge of the importance of selection and origin of growth, and the seedsman is altogether too busy a business man to attempt to convince them of that at a time when there is a shortage in the supply of selected seed. Were he to label the package of a certain seed showing the per cent of germination to be low, his customers would probably look for and use seed of higher percentage vitality, much to their own disadvantage.

No seedsman who values the reputation of his business would send out seed that would show a lower percentage vitality than at least two-thirds of the standard recommended for good seed. Yet the results of this and previous investigations show that occasional lots of field root and garden seeds of exceptionally low vitality continue to be offered in the retail trade. Careful inquiry has frequently been made for the purpose of ascertaining who is responsible for thus hazarding the best interests of both the seller and purchaser, and it has been usual to locate the fault with the local seed vendor who, in previous years, had over estimated the demand and in consequence had carried supplies over from year to year.

The competent seedsman must be a man of rare abilities. In addition to being a practical business man he must have a general knowledge of botany, plant breeding, seed selection, climatic environment and cultivation of the various kinds and varieties of plants, diseases of plants, and other branches of the science and practice of agriculture, horticulture and floriculture. His profession is one well worthy of the ambitions of students of agricultural colleges and universities. The progress of agriculture and horticulture in Canada will continue to be influenced to a very great extent by the application of intelligence to the business of seedsmen. Abundant opportunities are offered by the profession, and the country is in need of thoroughly trained men who will make it their life work.

HOW SAMPLES FOR INVESTIGATION ARE PROCURED.

The Trade Work.—The Seed Branch tests seeds for purity and vitality free of charge to farmers or seed merchants.

The information resulting from such tests is the property of the person or firm who supplied the sample, and except by his or their direction is not available to any other person. It is kept confidential by this Department of Agriculture and the results of such work are not made use of in any way in connection with the preparation of this bulletin.

The Investigation Work.—The 630 samples of seeds that were used in connection with this investigation were obtained by actual purchase on the part of official seed inspectors, from lots that were exposed for sale in the retail trade in various parts of all of the provinces during the months of April and May 1907.

The names of the wholesale and retail merchants were obtained with most of the samples.

HOW THE GERMINATION TESTS WERE CONDUCTED.

The testing of these samples for vitality was begun during the month of May and continued through the months of June and July. Duplicate tests were made of all the samples, and those which showed a low vitality were submitted to several tests to confirm the results obtained from the first tests.

The germination tests were all made in the Standard germinators used in the Seed Laboratory and at temperatures varying from 64° F. to 68° F. and 68° F to 86° F. depending on the kind of seed tested, in each case the lower temperature during the night and the higher temperature during the day. The most common substratum used was blotting paper, sterilized and free from any chemicals that might affect the germination of the seeds. Clay dishes were used for some seeds.

The tests lasted 10, 14 and 28 days, according to the kind of seed under examination.

How to make Practical Home Tests.

For each test, 100 seeds should be counted out and spread thinly over the surface of a piece of blotting paper, cotton or flannel cloth kept moist but not wet and placed in a shallow plate covered with a similar plate inverted so as to prevent too rapid evaporation; expose this to the temperature of a living roo and you will get approximate results.

The seed which has germinated ought to be counted twice during the test and removed from the plate.

The first counting (*i.e.* preliminary test) is most important on account of the fact that seed of fresh stock germinates quickly while old seed usually germinates slowly. At the end of the test, the seed which did not germinate may be considered as dead.

Duration of test for both preliminary and final is given for each kind of seed in the following tables.

The Publication of the Results.

From a careful examination and comparison of these tabulated results of vitality tests, combined with the statements of information sent in by the inspectors at time of procuring the samples, it would seem clear that condemnation, because of the sale of seeds of unusually low percentage vitality, is due more to the retail seed vendor than to the wholesale seed houses.

The response to germination tests of the seeds of an appreciable number of the samples indicate that the injudicious mixing of old seeds with fresh stocks is a common practice. Whether such injudicious mixing was done by the wholesale or retail merchant is difficult to ascertain. The mixing of old with fresh seeds is doubtless done to a greater or less extent by all who are engaged in the seed trade. The practice may not be seriously detrimental to the interests of farmers and gardeners if it is done by a competent and conscientious seedsman. He is not apt to lower the percentage vitality of the bulk lot to a point that may hazard the welfare of his customers and would determine the quantity, quality of stock and percentage vitality of his various stocks before mixing them. Without such care and knowledge, however, the mixing of old or worthless seeds with good fresh stocks is to be condemned. To publish the names of either or both the retail and wholesale merchant, together with the results of the vitality tests, in the tabulated statements presented in this bulletin would, in many instances, doubtless be unfair, unjust and useless to seed purchasers, since it is not definitely known which of the two (the retail or the wholesale merchant) should be held responsible. No doubt, each of them would disclaim responsibility and seek to place the blame on the other.

Field root seeds are usually sold in bulk to the retail vendors who carry over their supplies that remain unsold. It is believed that low percentage vitality of field root seeds offered in the retail trade is usually, but not always, due to a want of knowledge or carelessness on the part of retail vendors as to the age of the seed and the best conditions for storing supplies that have to be kept over by them. Retail merchants who have not a thorough knowledge of seeds should not hazard the interests of their customers by carrying over bulk stocks of carrot seeds and selling them without first making a test of their vitality.

The distributing seed houses are considered by the public to be responsible for the quality of their *papered seeds*. The vitality of good fresh stocks of *papered seeds* in the show cases of the wholesale seedsmen, however, may be seriously and unnecessarily reduced during the short time they are in possession of the retail vendor.

THE RESULTS.

In the following tables the results of the tests of corn are mentioned first. The field root and garden seeds are arranged according to the alphabetical order: 1st, of the most important kinds belonging to each botanical family; 2nd, of the different kinds in each family, so as to group the seeds which have the same characteristics and are tested in the same way.

The "Standards of germination for good seed" are given by many seed testing stations and by some of the European seed dealers and seed growers. Standards for some kinds of seeds could not be secured on account of their little importance in the seed trade.

INDIAN CORN.

Germinated between blotters at 68—86° F. Preliminary report in four days, final in ten days.

In making practical tests on the farm, instead of blotting paper, a piece of folded cotton can be used with a thick layer of sand above and underneath.

The vitality of seed corn is seriously affected by frost unless the seed is thoroughly matured and dried. The vitality is best preserved if unshelled. Corn growers would do well to purchase their supplies in the ear. Some growers market in that condition in one bushel crates (seventy-two pounds of ears). Vital seed will show a fresh, greenish and soft embryo when cut through.

FIELD CORN (SHELLED.)

Per cent of germination	Minimum	42
	Maximum	100
	Average	89
Standard for good seed		95

Laboratory test No.	Variety.	Per cent of Germination.		
		In 4 days.	In 5 days.	In 10 days.
		%	%	%
16	Angel of Midnight	40	68	93
528	“	92	93	94
593	Best		76	82
109	Best Old Squaw		39	44
212	Old Squaw	73		91
119	Squaw	29	33	42
428	“	42	42	98
488	“	93		97
492	“	94		96
210	“	93		98
433	Sioux or Squaw	96	96	96
3	Champion Early	60	61	63
117	Compton's Early	79	82	88
193	“	78	79	80
466	“	80		82
467	“		67	69
404	Cuban Giant	73		75
310	Dakota Sunshine	42	65	85
474	Early Butler		83	85
477	“	90	92	92
478	“	100	100	100
421	Fordhook	73		89
313	Gehie Yellow Flint	51		83
211	Horse Tooth	64		71
295	Iowa Gold Mine		76	81
297	Iowa Silver Mine		66	90
35	King of Earlies	97	97	97
473	King Philip		89	90
378	Brown Leaming		64	70
22	Leaming		70	97
398	“	54	81	86
296	Longfellow		69	84
469	“		77	82
476	“	80	82	82
151	McKenzie's Euchre	93	93	95
105	North West Queen		84	87
123	North West Squaw		100	100
302	North Western Dent		58	87

Laboratory test No.	Varities.	Per cent of Germination.		
		In 4 days.	In 5 days.	In 10 days.
		%	%	%
304	North Dakota Flint	63	86	96
388	North Dakota White Flint	88	89	89
312	Dakota White Flint	33	....	86
470	White Flint	....	76	80
29	Peep O'Day	94	....	97
519	Puras Prolific	....	92	93
399	Red Cob	34	64	75
298	Thoroughbred White Flint	....	55	85
400	White Cap Yellow Dent	72	....	77
468	“ “	....	98	98
301	Square Deal Yellow Dent	....	79	93

FIELD CORN (ON EAR).

Laboratory test No.	Varities.	In 4 days.	In 5 days.	In 10 days.
254	Canadian Yellow	78	100	100
411	Longfellow	....	96	99
412	“	95	....	99
413	“	51	94	96
414	“	85	90	91
415	“	67	98	99
416	“	91	96	96
479	“	29	93	100
480	“	39	92	98
417	Mixed Longfellow	99	99	99
418	“	96	100	100
419	“	84	98	99
409	Red Blaze of Smut Nose	95	....	99
525	Red	5	32	97
406	Thoroughbred White Flint	79	86	88
407	“ “	87	....	100
408	“ “	61	....	100
482	....	77	99	99

SWEET CORN (SHELLED).

Percent of germination	Minimum	48
	Maximum	100
	Average	85
Standard for good seed		95

Laboratory test No.	Varities.	In 4 days.	In 5 days.	In 10 days.
152	Country Gentleman	28	63	90
224	Crosby's Early Sugar	....	44	48
343	“	....	42	52
401	Early Giant	76	....	88
66	Cory	81	84	84
9	Early Cory	96	96	96
23	“	4	19	93
217	“	25	....	76
101	Early White Cory	....	44	86
429	Extra Early White Cory	84	87	90
185	Sweet Early White Cory	12	38	80
300	Early Early White Cob	....	24	62
181	Early Sweet or Sugar	34	78	91
189	Evergreen	21	58	86
619	“	....	56	68
108	Stowell's Evergreen	....	48	52
150	“	83	87	89
153	“	65	67	70
156	“	....	92	93
186	“	42	82	87
290	“		79	85
375	“	45	....	94
420	“	64	82	88
471	“	....	76	80
110	Stowell's	....	53	92
380	Metropolitan	54	68	85
371	Mammoth Sweet	39	....	59
472	“	....	86	88
475	“	....	89	89
376	New Market	....	97	98
267	Perry's Hybrid Sweet	72	....	74
368	Peck's Improved Crosby	45	....	97
464	White Mexican	78	....	79
307	....	33	56	91
484	....	88	89	89
486	....	65	77	77
187	....	58	89	90

SWEET CORN (ON EAR).

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
481	Mammoth White Cory	80	....	85
526	Stowell's Evergreen	22	69	100

ASPARAGUS (*Asparagus officinalis, L.*)

Germination test at 68–86° F. between blotting papers or cloths. Preliminary report in six days, final report in fourteen days. This seed is better soaked for twelve hours before being put into the germinator. Should be sown about one inch deep.

Standard per cent of germination for good seed	85

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
191	Conover's Colossal	38	66

BEANS (*Phaseolus vulgaris, L. and Var.*)

Germinated at 68–86° F. between blotters or cloths. Preliminary report in four days, final in ten days. The germinating seed of bean being very soft, it is not advisable to sow before all danger of frost is over. Depth of seeding, about 2 inches.

Viable seed, when cut through with a knife, must show a greenish, fresh and tender embryo. Vitality keeps for about five years.

Under the same head the seeds of Peas (*Pisum sativum, L.*) can be mentioned as having the same characteristics, therefore as being handled in the same way.

BEANS.

Per cent of germination	Minimum	60
	Maximum	100
	Average	84
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
352	Broad Windsor	52	....	88
438	Black Wax	84	....	100
287	Dwarf Black Seeded Wax	....	62	82
116	Golden Wax	55	....	93
124	" "	....	52	82
207	" "	84	....	87
208	Early Red Valentine	90	....	96
89	Red Valentine	44	....	60
630	Valentine	76	....	84
353	Round Yellow Six Weeks	58	....	68

PEASE.

Per cent of Germination	Minimum	33
	Maximum	98
	Average	87
Standard for good seed		97

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
618	American Wonder	92		92
154	Extra Early	96		97
94	May's North West Premier	81		88
465	McLean's Little Gem	7		87
595	" "	90		91
289	Premier Gem		85	86
347	Stratagem	92		92
125	William Hurst		77	92
120		84		91
303		97		98
305		31		33
306		83		84
346		96		96

BEETS AND MANGELS (*Beta Vulgaris, L. and Var.*)

Germinate on clay dishes at 68–86° F. after having been soaked for 12 hours. Preliminary report in five days, final in fourteen days. The balls sold in the trade which are commonly called seeds are really agglomerations of from three to five fruits, each fruit containing one seed. An average germination of two sprouts per seed ball can be expected from good samples.

If properly stored, beet and mangel seed will retain its vitality for four to five years.

Sow one inch deep and roll or pack the soil so as to have the seeds in good contact with the soil.

BEET.

		Balls.	Sprouts.
Per cent of germination	Minimum	65	96
	Maximum	97	297
	Average	85	168
Standard for good seed		90	160

Laboratory test No.	Variety.	Per Cent of Germination.			
		In 5 Days.		In 14 Days.	
		Balls.	Sprouts.	Balls.	Sprouts.
531	Blood Turnip	52	118	79	167
365	"	81	117	92	172
141	Early Blood Turnip	80	134	86	154
341	" "	72	123	82	158
446	" "	88	163	96	208
424	" "	68	102	83	148
177	Early Blood Turnip Improved	76	149	78	166
244	" " "	92	199	97	297
351	" " "	67	87	75	121
205	Darl Red Turnip	91	193	92	209
163	Early Dark Red Flat Egyptian	64	94	78	140
288	Early Egyptian Turnip	70	107	83	147
202	Early Flat Egyptian Turnip	80	148	88	173
460	Extra Early Egyptian	81	127	84	141
242	Egyptian Flat Round	88	163	92	190
623	Egyptian Round	83	152	89	193
587	Flat Egyptian	62	93	80	154
605	"	65	80	81	123
107	Edmond's Early Turnip	48	69	62	102
606	Eclipse Turnip	65	88	79	124

BEET—*Continued.*

Laboratory test No.	Variety.	Per Cent of Germination.			
		In 5 Days.		In 14 Days.	
		Balls.	Sprouts.	Balls.	Sprouts.
529	Eclipse	71	99	74	103
90	“	17	23	63	97
562	Early Eclipse	84	140	91	178
557	“	81	129	88	153
98	“	77	122	87	153
58	“	76	128	83	142
445	Extra Early Eclipse	57	74	65	96
431	Early Eclipse Turnip	64	85	86	142
502	“ “	91	169	94	203
52	French White Sugar Red Top	61	115	73	148
462	“ “	54	99	79	163
349	“ “	46	55	94	189
369	Giant Rose (Sugar Beet)	54	84	69	135
367	“ “	92	126	96	200
532	Long Blood	89	186	96	231
505	Long Smooth Blood	63	130	73	161
437	“	88	199	95	252
570	Half Long Blood	72	133	99	280
561	Half Long Deep Blood Red	86	157	89	196
461	“ “	33	39	76	125
542	Sugar Beet	57	83	78	137
38		32	40	94	203

MANGEL.

		Balls.	Sprouts.
Per cent of germination	Minimum	7	9
	Maximum	96	263
	Average	85	203
Standard for good seed		90	160

Laboratory test No	Variety.	Per Cent of Germination.			
		In 5 Days.		In 14 Days.	
		Balls.	Sprouts.	Balls.	Sprouts.
583	Dignity	74	139	92	216
487	‘E’	70	111	89	165
118	Giant Yellow	74	131	99	226
372	Giant Yellow Oval	59	81	66	116
370	Giant Yellow Globe	22	27	83	159
574	Yellow Globe	83	157	88	203
294	Golden Fleshed Tankard	64	106	84	182
491	Golden Tankard	33	63	74	177
24	Tankard	65	101	66	102
582	Half Sugar	87	155	95	189
379	Sugar	65	85	67	87
514	Sugar Rose	50	65	97	191
95	Long Red	86	184	96	263
402	“	57	77	74	135
501	“	28	36	67	124
575	“	41	72	75	157
576	“	33	44	83	175
591	Long Red Best	73	121	93	195
206	Mammoth Long Red	71	172	83	190
215	“ “	75	161	87	205
590	Prize Mammoth Long Red	79	155	93	223
1	Yellow Intermediate	66	106	82	164
30	“	81	176	81	177
91	“	44	58	76	166
155	“	40	56	79	169
387	“	24	29	37	63
25		..	...	7	9
97		64	92	88	189
223		11	24	33	58
293		69	133	84	186
422		72	132	92	245

CABBAGE (*Brassica oleracea*, L., Var. *Capitata D.C.*)
CAULIFLOWER (*Brassica oleracea*, L., Var. *Botrytis D.C.*)
KALE (*Brassica oleracea*, L., Var. *Acephala D.C.*)
RADISH (*Raphanus sativus*, L.)
RAPE (*Brassica napus*, L.)
TURNIP (*Brassica campestris*, L.)

The seeds of all these plants belonging to the *Genus Brassica* and *Raphanus* (radish only) of the Mustard family are very rich in oil. While seeds of mustard for instance keep their vitality for 20 years or more, it is not advisable to use seeds of cultivated varieties when they are four or more years old. Old stocks sometimes have a musty odor.

The seeds have to be planted about 2 inches deep.

Germinate in blotters or cloths at from 68–86 F.

Preliminary test in four days, final test in ten days.

CABBAGE.

Per cent of germination	Minimum	62
	Maximum	98
	Average	82
Standard for good seed		93

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
15	All Seasons		95	97
147	“	97		98
260	Early Winningstadt	63		68
4	“		82	84
324	“	53		62
361	“	77		82
396	“	76		79
615	“	72		81
148	Winningstadt	82		87
453	“		77	83
617	“	74		80
320	Early Jersey Wakefield		89	90
190	“ “	86		89
135	Early Blood Red Drumhead		74	81
440	Early Summer	58		63
556	Early York	70		79
231	Fottler's Drumhead	88		88
427	Henderson's Early Summer	89		90
161	Large Late Red Dutch Drumhead	64		81
269	Large Late Drumhead	85		90
176	Mammoth Rock Red		87	90
234	“	83		84
339	“		77	81
56	Premium Large Drumhead	73		83
397	“ “	74		98
498	Premium Flat Dutch		82	86
385	Simmer's Perfection Drumhead		56	68

CAULIFLOWER.

Per cent of germination	Minimum	90
	Maximum	99
	Average	97
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 4 Days.	In 10 Days.
596	Demi Dur (Half Early)	99	99
53	Early Favourite	95	98
253	“	98	99
232	Early Snowball	94	96
328	Early Paris	95	97
264	Le Normand Short Stem	89	90

KALE.

Per cent of germination..........................Average............ 79

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
63	Fall Green Curled Scotch	55	....	69
179	“ “	....	85	88

RADISH.

Per cent of germination........................ Minimum............ 51
Maximum............ 100
Average............ 89
Average for good seed.. 95

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
457	Black Spanish	99	....	99
88	Chartier	....	98	98
451	China Rose Winter	91	....	91
602	Chartier's Special	94	....	95
40	English Scarlet Turnip	91	....	93
70	Early Scarlet Olive	....	84	88
115	“	....	84	88
143	Early White Turnip	100	....	100
169	Early Long Scarlet Short Top	99	....	100
348	Early White Turnip	95	....	98
495	Early Scarlet Globe	99	....	99
548	Early Scarlet Turnip	77	....	82
551	“	80	....	81
182	“	74	....	75
566	Early Scarlet Turnip Root	95	....	95
50	French Breakfast	99	....	99
92	“	99	....	99
216	“	81	....	87
249	“	85	....	86
314	“	....	95	98
354	“	97	....	98
11	Improved Long Scarlet	....	86	87
390	Long Scarlet	68	....	76
203	Olive Shaped French Breakfast	83	....	85
14	Rosy Gem White Tipped	....	96	100
229	“ “	....	85	89
332	“ “	94	....	95
128	Scarlet Ball	97	....	99
197	Scarlet China Water	67	....	67
439	Scarlet Olive Shaped	46	....	51
512	“	47	....	53
599	Scarlet Turnip	100	....	100
33	Turnip	....	90	91
280	Turnip varieties mixed	78	....	82
620	White Chinese	100	....	100

RAPE.

Per cent of germination..........................Average............ 98
Standard for good seed.. 95

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
48	....	99	100
79	....	79	95

TURNIP.

Per cent of germination	Minimum	16
	Maximum	100
	Average	71
Standard for good seed		95

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 3 Days.	In 4 Days.	In 10 Days.
483	“A”		99	99
102	Carter's Imperial		85	91
103	“		66	84
122	“		47	74
213	“		85	94
214	“		86	93
589	Carter's Hazalds Imperial		96	96
586	Carter's Heavy Copper Purple Top		94	95
218	“		94	95
311	“		95	96
220	“	93		95
69	Early White Flat Dutch	66		71
322	“ “		93	96
173	Early White Flat Dutch, Strap Leaf	76		83
246	“ “ “		87	91
384	Early Snowball		94	98
493	Early Purple Top		87	90
563	“ Strap Leaf	84		85
515	Elephant Swede		40	52
579	“		66	76
111	East Lothian Swede		72	86
434	Flat Dutch		79	83
377	Grey Stone		94	96
436	Golden Ball		91	94
518	“		83	87
291	Hartley's Bronzed Sweet		98	99
616	Hall's Westburg		99	99
592	“ Purple Top Swede		91	96
222	Improved Purple Top Yellow	99		100
517	Imperial Swede		64	78
8	Jumbo Swede	82		89
157	“		59	75
516	Kangaroo Swede		24	39
577	“		44	59
184	Laing's Swede		19	64
490	“ Imp. Purple Top Swede		94	97
456	McKenzie N.W. Purple Top Swede	45		71
27	New Century Swede		32	95
121	Orange Jelly		59	70
188	Purple Top		15	28
308	“		63	72
395	“		46	69
403	“		84	90
17	Purple Top Swede		53	61
219	“	68		81
392	Purple Top Strap Leaf		97	98
82	“ “ Flat	100		100
521	Purple Top Aberdeen		88	93
292	Purple Top Yellow Aberdeen	88		92
540	“ “		99	99
588	Purple Top Mammoth		81	83
28	Red Top		21	38
520	Red Top Milan		84	91
228	Rennie's Prize Swede		94	97
558	“		90	91
41	Swede		96	99
281	Steele Briggs Swede	69		81
444	“		73	83
373	Swede Perfection		36	52
299	Swede Kerving Purple		94	96
541	Sutton's Champion		97	98
104	Western Swede		53	72
323	White Egg		81	82
522	White Globe		99	99
581	“		85	87
533	White Strap Leaf		95	98
2	Yellow Aberdeen	73		88
112	“		71	78
463	“	92		95
585	“		84	87
26			8	16
309			93	97

CARROT (*Daucus Carota*, L.)

Germinate at 68-86° F. in blotters. Preliminary report in six days, final in fourteen days.

The seed is better soaked for 12 hours before being put in the germinator. It is recommended by some to have carrot seeds kept for two or three days in a heap after having been well dampened, so as to hasten the germination after sowing. Sow shallow and roll.

Fresh seed has a strong characteristic odor, especially when rubbed between the hands. This odor becomes less strong with the age of the seed.

CARROT.

Per cent of germination	Minimum	2
	Maximum	97
	Average	70
Standard for good seed		80

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 5 Days.	In 6 Days.	In 10 Days.
160	Chantenay Half Long		71	76
572	"		61	64
357	Chantenay		79	80
537	"		32	37
565	" Half Long Scarlet	71		77
87	Danvers Half Long		59	69
93	"		61	66
450	"		82	86
489	Danvers		60	77
534	"		89	91
578	Early Horn		46	49
167	Early Half Long		49	51
549	"		55	61
44	Early Scarlet Horn		82	85
127	"		67	76
226	"		87	89
435	"		39	44
538	"		53	56
539	Early Funde Horn		67	72
20	Early Scarlet Short Horn		18	23
204	" "	68		76
510	" "		41	44
10	Guerande or Ox-Heart		86	88
61	" "	20		33
282	" "		75	77
443	" "	64		70
513	" "		66	67
560	" "	33		43
37	" "	80		85
319	" "		86	87
336	" "		78	82
535	" "		27	61
628	" "		93	97
366	Half Long		79	80
600	" Luc		63	70
199	" Scarlet Nantes	69		84
459	" "		58	60
330	" Scarlet Luc Danvers		59	64
500	Improved Long Orange		73	74
254	" "		34	42
374	Improved Short White		13	14
383	Improved Scarlet Intermediate		47	33
530	Jast Intermediate		46	52
221	Large White Belgian		13	22
536	Long Orange		63	66
571	"			2
34	Mammoth White		23	26
594	Red Scarlet Intermediate (best)		81	82
18	Short White		14	20
96	"		17	20
106	"		87	88
448	Scarlet Horn		61	61
158	Vosges		42	46
7	White Vosges		26	28
527	"		83	84
523	White Belgian		69	72
573	White Half Long Vosges		12	14
45			62	64
423		48		50
485			73	77

CELERY (*Apium graveolens*, L.)

Celery belongs to the same family as Carrot, *i.e.* to the Umbelliferae and its seeds having the same characteristic nature are treated in the same way as those of Carrot, except that they germinate best on clay dishes, such as a moist saucer from a flower pot.

Per cent of germination	Minimum	3
	Maximum	70
	Average	38
Standard for good seed		60

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
499	Evan's Triumph		55
252	Golden Yellow Self Blanching	21	40
345	Golden Self Blanching		62
139	Giant Pascal	14	34
318	"	16	70
624	Prague Giant		6
452	Pink Plume	3	36
236	White Plume	4	24
276	"		3
363	"		62
555	"		5
389	White Solid	38	70

CRESS (*Lepidium Sativum*, L. and *Nasturtium officinale*, L.)

Germinated in blotters at 64–68° F. Preliminary tests in three days, final in ten days.

Per cent of germination	Minimum	84
	Maximum	100
	Average	94

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
129	Extra Triple Curled	100	100
270	Extra Curled Garden	80	87
381	Extra Curled	99	99
49		98	99
391		76	84

CITRON (*Citrullus Vulgaris*, L., Var.)
CUCUMBER (*Cucumis sativus*, L.)
MARROW (*Cucurbita maxima*, Duschen)
MUSK MELON (*Cucumis Melo*, L.)
PUMPKIN (*Cucurbita Melopepo*, L.)
SQUASH (*Cucurbita Maxima*, Duschen.)
WATER MELON (*Citrullus vulgaris*, L.)

All these plants belong to the Cucurbitaceae and the seeds have common characteristics. They are germinated at 68–86° F. in blotters, the preliminary report being sent in three days, the final in ten days.

The seeds may be sown from one-half to one inch deep and pressed in the soil. Cucurbitaceae seeds generally keep their vitality for several years, provided that they have been kept in good condition.

Our tests of all these Cucurbitaceae might not be as accurate as they should be on account of the fact that most of the packages did not contain more than 100, some of them only fifty or even 25 seeds.

CITRON.

Per cent of germination........................ Average............ 90

Laboratory test. No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
277	Preserving	96	100
126		36	80
382		72	90

CUCUMBER.

Per cent of germination	Minimum	67
	Maximum	98
	Average	86
Standard for good seed		90

Laboratory test No.	Variety	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
166	Boston Pickling	58	73
137	Chicago Pickling	61	96
237	"	71	84
603	"	92	95
19	Ely Cluster	60	75
86	Early Frame	72	77
99	"	53	67
201	Early White Spine	92	96
507	"	86	86
550	"	81	82
5	Green Prolific	71	85
73	Improved Long Green	85	89
81	"	67	88
247	"	96	97
612	Improved Early White Spine	86	89
355	Long Green	57	70
285	Short Green	82	83
159	Wethersfield's Chicago Pickling	91	92
567	" "	97	98

MARROW.

Laboratory test. No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
130	Boston	84	92

MUSK MELON.

Per cent of germination	Minimum	72
	Maximum	99
	Average	85
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
62	Improved Large Green Nutmeg	96	99
170	“ “	59	72
238	Montreal Nutmeg	97	97
364	Miller's Cream	50	76
279	Surprise	75	83

PUMPKIN.

Per cent of germination	Minimum	74
	Maximum	100
	Average	89
Standard for good seed		85

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
195	Cheese or Kentucky	88	92
272	“	80	80
511	“	68	74
611	Japanese Pie	90	90
140	Large Cheese	82	82
243	“	98	98
329	“	100	100
559	“	98	98

SQUASH.

Per cent of germination	Minimum	76
	Maximum	100
	Average	87
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
194	Boston Marrow	44	76
604	English Vegetable Marrow	86	88
175	English Yellow Bush Scallop	64	96
64	Hubbard	56	80
83	“	88	96
240	“	88	88
284	“	64	76
506	“	92	92
546	“	88	92
553	“ —	100	100
261	Mammoth Summer Crookneck	60	68
569	Mammoth Queen Crookneck	44	80
334		90	92

WATER MELON.

Per cent of germination { Minimum 56; Maximum 98; Average 78

Standard for good seed 90

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 3 Days.	In 10 Days.
164	Black Spanish	96	98
359	Cole's Early	55	68
386	Cuban Queen	14	56
67	Kolb's Gem		64
268	Peerless	80	88
168	“	40	66
326	“	22	76
241	“	86	86
327		80	80
331..		81	88
598		26	84

LEEK (*Alliun Porum*, L.)

The seeds of Leek like those of Onion (*Allium Cepa*, L.) are germinated in blotters at 68–86° F. Preliminary report in 5 days, final report in 10 days. Vitality retained from three to six years. Sow one quarter to one half inch deep and press in the soil.

Per cent of germination { Minimum 11; Maximum 76; Average 40

Laboratory test No.	Variety.	Per Cent of Germination	
		In 5 Days.	In 10 Days.
262	Broad Flag	6	11
138	Broad London or English	72	76
335	English Flag	22	31
607	“	48	57
393		19	26

ONION.

Per cent of germination	Minimum Maximum Average	26 97 85
Standard for good seed		90

Laboratory test No.	Variety.	PER CENT OF GERMINATION.		
		In 4 Days.	In 5 Days.	In 10 Days.
426	Australian Brown	74		95
209	Bartletta		85	92
316	"	54		78
72	Extra Early Red		76	79
183	"		91	91
442	"		63	66
564	"		77	80
131	Early White Bartletta		25	38
12	Large Red Wethersfield		70	73
13	" "		73	77
80	" "		84	89
146	" "		88	89
180	" "		76	76
192	" "	24		37
196	" "		59	67
394	" "		65	68
31	Red Wethersfield		53	62
239	Small Silverskin		66	72
333	"		72	76
499	Southport White Globe		80	81
258	White Portugal		67	68
626	White Giant		50	65
47	Yellow Globe Danvers		75	78
225	" "	45		75
274	" "	16		26
601	" "		83	85
71	Yellow Danvers		95	97
509	"		34	39
430	Danvers Yellow Globe		72	76
162	Large Yellow Globe Danvers		66	69
133	Prizetaker		97	97

LETTUCE (*Lactuca sativa, L.* and Var.)

Germination in blotters at 64° to 68° F. Preliminary report in four days, final report in ten days.

Sow from one quarter to one half inch deep.

Per cent of germination	Minimum Maximum Average	76 100 95
Standard for good seed		90

Laboratory test No.	Variety.	PER CENT OF GERMINATION.	
		In 4 Days.	In 10 Days.
257	Black Seeded Simpson	18	83
317	Big Boston	88	88
36	Early Curled Silesian	95	98
503	" "	93	96
275	Early Prize Head	66	76
441	" "	86	90
51	Ferry's Prize Head	100	100
358	Prize Head	90	92
145	Hanson	99	100
552	"	99	99
497	" Head	97	98
609	Iceberg	98	98
178	Mammoth Black Seeded Butter	99	100
338	Nonpareil	100	100
200	Nonpareil Cabbage	98	98
227	"	100	100
544	"	29	88
77	Simpson's Early Curled	100	100
622	Selley	98	99
84	Rennie Ball White Seeded	94	98

PARSLEY (*Petroselinum sativum*, Hoff.)

PARSNIP (*Pastinaca sativa*, L.)

Parsley and Parsnip can be included with Carrot in regard to the germinative qualities of their seed. The test however lasts longer, the preliminary report requiring fourteen and the final report 28 days. These seeds have to be sown one half to one inch deep. Seed more than one year old is likely to be low in percentage vitality.

PARSLEY.

Per cent of germination	Minimum	25
	Maximum	85
	Average	50

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 14 Days.	In 28 Days.
55	Champion Moss Curled	48	48
250	“ “	31	35
545	Curled	22	25
342	Moss Curled	82	85
43		43	50
621		54	57

PARSNIP.

Per cent of germination	Minimum	10
	Maximum	68
	Average	42
Standard for good seed		65

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 14 Days.	In 28 Days.
6	Hollow Crown	35	37
85	“	66	68
149	“	36	38
198	“	31	33
230	“	27	33
325	“	32	38
425	“	41	46
496	“	58	58
508	“	28	28
580	“	54	62
584	“	38	40
608	“	10	11
68	Long White Dutch	10	15
100	“	45	47
248	Long White Dutch or Sugar	30	35
543	Long Dutch Hollow Crown	39	43
136	Manitoba Prize Intermediate	8	10
614	New Intermediate	58	59
286	Sutton's Student	53	56
32		48	49
42		58	59
356		52	58

PEPPER (*Capsicum*, L.) Varieties.

Seeds germinated at 68° to 86° F. in blotters.
Preliminary test, 6 days; final test, 14 days.

Per cent of germination	Minimum	38
	Maximum	82
	Average	52

Laboratory test No.	Variety.	PER CENT OF GERMINATION.	
		In 6 Days.	In 14 Days.
266	Large Red	15	38
60	Large Bell or Bull Nose	47	57
357	Ruby King	80	82
251	"	47	51
233	"	26	29

RHUBARB (*Rheum raphonticum*, L.)

Germinated in blotters at 64° to 68° F. Preliminary test in six days, final test in fourteen days. Good seed germinates quickly if sown not over one inch deep. The seed of Rhubarb cannot be relied upon as to the true reproduction of the variety.

Per cent of germination	Minimum	64
	Maximum	89
	Average	79

Laboratory test No.	Variety.	PER CENT OF GERMINATION.	
		In 6 Days.	In 14 Days.
454	Johnston's St. Martin's	66	72
315	Linnaeus	86	89
134	Victoria	46	80
39		79	89
74		33	64

MARJORAM (*Origanum Majorina*, L.)
SAGE (*Salvia officinalis*, L.)
SAVORY (*Satureia hortensis*, L.)
THYME (*Thymus vulgaris*, L.)

Often called "Herbs", belong to the Labiatæ family.

All are germinated in blotters at 68° to 86° F. Preliminary test in six days, final in fourteen days. When more than two or three years old these seeds are not to be relied upon.

MARJORAM.

Laboratory test No.	Variety.	PER CENT OF GERMINATION.	
		In 6 Days.	In 14 Days.
625		69	73

SAGE.

Per cent of germination	Minimum	60
	Maximum	92
	Average	70

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
283	Broad Leaved	61	64
54	English Broad Leaf	37	66
171	"	57	65
263	"	38	60
142		84	92
597		61	73

SAVORY.

Per cent of germination	Minimum	21
	Maximum	39
	Average	31

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
78	Summer	15	21
132	"	34	39
165	"	17	27
278	" or Annual	20	36

THYME.

Per cent of germination..........Average.......... 71

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
59		67	71
172		67	71

SALSIFY (*Trapogopogen porrifolius*, L.)

The seeds of Salsify are germinated in blotters at 68° to 86° F. Preliminary test in six days, final in 10 days. Seeds should be sown about one inch deep.

Per cent of germination	Minimum	19
	Maximum	92
	Average	50
Standard for good seed		85

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 10 Days.
321	Mammoth Sandwich Island	14	26
455	" "	46	59
458	" "	89	89
610	" "	88	92
75		43	50
113		33	46
174		23	28
245		40	50
265		16	37
362		14	19

SPINACH (*Spinacia oleracea*, L.)

Germination test in blotters at a temperature of 64° to 68° F. Preliminary test in 5 days; final test in 10 days. It is recommended to soak the seeds for six hours before sowing.

Per cent of germination	Minimum	25
	Maximum	93
	Average	46
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 5 Days.	In 10 Days.
350	Long Standing	60	89
255	Prickly Winter	12	25
76	Round Summer	41	51
340	"	52	84
273	Thick-leaved Summer	28	55
144	Victoria	75	93
360	"	34	67

TOBACCO (*Nicotiana Tabacum*, L.)

Germinated at 68° to 86° F. in blotters. Preliminary test in six days, final test in 14 days. Rolling after sowing is recommended.

Laboratory test No.	Variety.	Per Cent of Germination.	
		In 6 Days.	In 14 Days.
259	Connecticut Seed Leaf	34	53

TOMATO (*Lycopersicum esculentum*, L.)

Germination at 68° to 86° C. in blotters. Preliminary test in 4 days; final test in 10 days. The seeds of Tomato should be sown about one half inch deep.

Per cent of germination	Minimum	62
	Maximum	100
	Average	85
Standard for good seed		90

Laboratory test No.	Variety.	Per Cent of Germination.		
		In 4 Days.	In 5 Days.	In 10 Days.
494	Acme	63		76
271	Beauty	51		62
21	Dwarf Champion	37		100
235	"	91		96
344	"	92		96
432	Early Dominion Day	88		94
504	Earliest of All		70	77
554	Early Ruby	72		87
114	Optimus		79	88
256	"	79		86
57	Perfection	63		79
547	"	67		83
613	Trophy	96		100
46		57		69

SUMMARY OF RESULTS.

PER CENT OF GERMINATION AT FINAL TEST.

Kind of Seed.	Minimum.		Maximum.		Average.	
Asparagus					66	
Beans	60		100		84	
Pease	33		98		87	
	Balls.	Sprouts.	Balls.	Sprouts.	Balls.	Sprouts.
Beet	62	102	99	280	85	168
Mangel	7	9	99	226	85	204
Cabbage	62		98		82	
Cauliflower	90		99		97	
Kale					79	
Radish	51		100		89	
Rape	95		100		98	
Turnip	16		100		71	
Carrot	0.2		97		70	
Celery	3		70		38	
Sweet Corn	48		100		85	
Field Corn	42		100		89	
Cress	84		100		94	
Citron	80		100		90	
Cucumber	67		98		86	
Marrow					92	
Muskmelon	72		99		85	
Pumpkin	74		100		89	
Squash	76		100		87	
Watermelon	56		98		78	
Leek	11		76		40	
Onion	26		97		85	
Lettuce	76		100		95	
Parsley	25		85		50	
Parsnip	10		68		42	
Pepper	38		82		51	
Rhubarb	64		89		79	
Sage	60		92		70	
Savory	21		39		31	
Thyme					71	
Salsify	19		92		50	
Spinach	25		93		46	
Tobacco					53	
Tomato	62		100		85	

Kind of Seed.	Number of Samples Tested.	PER CENT OF GERMINATION.				NUMBER OF SAMPLES.	
		Min.	Max.	Average.	Standard for Good Seed.	Vitality up to standard for good seed.	Vitality less than two-thirds of standard for good seed.
Corn (Sweet)	39	48	100	85	95	4	5
" (Field)	66	42	100	90	95	29	2
Asparagus	1	....	....	66	85	....	....
Beans	10	60	100	84	90	3	....
Peas	13	33	98	87	97	2	1
Beet	42	96	297	168	160	20	4
Mangel	31	9	263	203	160	21	5
Cabbage	27	62	98	82	93	3	....
Cauliflower	6	90	99	97	90	6	....
Kale	2	69	88	79	90	....	....
Radish	35	51	100	89	95	17	2
Rape	2	95	100	98	95	2	....
Turnip	72	16	100	71	95	26	8
Carrot	60	2	97	70	80	15	21
Celery	12	....	....	....	....	....	....
Cress	5	84	100	94	....	....	....
Citron	3	80	100	90	92	2	....
Cucumber	19	67	98	86	90	6	....
Musk melon	5	72	99	85	90	2	....
Pumpkin	8	74	100	89	90	5	....
Squash	13	76	100	87	90	6	....
Watermelon	11	56	98	78	90	1	1
Leek	5	11	76	40	....	....	....
Onion	31	26	97	85	90	5	4
Lettuce	20	76	100	95	90	16	....
Parsley	6	25	85	50	65	1	2
Parsnip	22	10	68	42	65	1	11
Pepper	5	38	82	52	....	....	....
Rhubarb	5	64	89	79	....	....	....
Sage	6	60	92	70	....	....	....
Savory	4	21	39	31	....	....	....
Thyme	2	....	....	71	....	....	....
Marjoram	1	....	....	73	....	....	....
Salsify	10	19	92	50	85	2	7
Spinach	7	25	93	46	90	1	3
Tobacco	1	....	....	53	....	....	....
Tomato	14	62	100	85	90	5	......
Total samples tested	621	....	....	....	....	91	76

CONCLUSIONS AND SUGGESTIONS.

Farmers and gardeners should know the percentage vitality of seeds before planting them. Allowance may then be made for seed that will not germinate.

Grocers, druggists, and other business men who have not a fair knowledge of agriculture, horticulture and plant life in general, cannot be expected fully to safeguard the best interests of seed purchasers, except in the sale of carton or papered seeds when sold on commission for responsible seed houses.

If the conditions of soil and weather be favourable to rapid germination, and the seeds be planted at the proper depth for the kind and sown at the commonly prescribed rate per given area, seed that will germinate in the proportion of not less than two thirds of the percentage standard recommended for good seed will be found usually to give a fairly satisfactory stand of plants with most kinds of crops.

As a further protection to seed users, it is expedient that this investigation work be continued from year to year and that in future the results of carefully conducted germination tests be published whenever the percentage of vital seeds falls below at least two thirds of the percentage standard recommended for good seeds of the kind, and that the name or names of persons or firms who are believed to be in whole or in part responsible for the sale of such seeds of low vitality be published together with the results of germination tests.

The advisability of encouraging the production in quantity for commerce, of Canadian grown selected stocks of some of the kinds of field root seeds and garden seeds, is worthy of careful consideration. In the meantime, the available evidence as to the advantages that accrue to farmers and gardeners, from the use of home grown instead of imported stocks of field root and garden seeds, is not fully conclusive.

The best obtainable seeds are always the cheapest in the end. Inferior seeds are apt to prove to be expensive at any price.

Competent and conscientious seed merchants consider quality before cost; in consequence, they have few complaints from their customers.

INDEX

PAGE.
Seed Trade Investigation 5
The Quality of the Seed. Importance of Vitality 5
Sources of Supply 5
The distribution of Seeds 6
Storage of Seeds 7
About Guarantee of Quality 7
The Non-Warranty Clause 8
The Reputation of a Seed House 8
How samples for Investigation are procured 9
How the germination tests were conducted 9
How to make practical home tests 10
The publication of the results 10
The Results 11
Corn, Field varieties 11
Corn, Sweet varieties 12
Asparagus 13
Beans 13
Peas 14
Beets 14
Mangels 14
Cabbage, Cauliflower, Kale, Radish, Rape, Turnip 16
Carrot 19
Celery 20
Cress 20
Citron, Cucumber, Marrow, Musk Melon, Pumpkin, Squash, Water Melon 21
Leek 23
Onion 24
Lettuce 24
Parsley, Parsnip 25
Pepper 26
Rhubarb 26
Marjoram, Sage, Savory, Thyme 26
Salsify 28
Spinach 28
Tobacco 28
Tomato 29
Summary of Results 29
Conclusions and Suggestions 31